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The Majella National Park: a case study for the conservation of plant biodiversity in the Italian Apennines

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Abstract

The Majella National Park (MNP) is a tangible example of the interaction between *ex-situ* and *in-situ* conservation of endemic, rare, or endangered species at a Regional level in the context of the Italian national parks. The MNP has the facilities and carries out activities for the conservation of plant biodiversity: it includes botanical gardens, a seed bank, a nursery, and a network of "guardian farmers", an authentic "granary" in which to protect and conserve biodiversity in and around the Majella massif (central Italy).

Keywords

Ex-situ conservation, plant biodiversity, seed bank, restocking

Introduction

The deterioration of the conservation status of many species is well documented (e.g., Dirzo et al. 2014). Declining biodiversity is due to the burgeoning world human population that is perpetuating the unsustainable use of natural resources (Wilson 2016).

The overall goal of conservation is to mitigate the loss of biodiversity and preserve ecosystem services, species, and genetic diversity for the future (Schwartz et al. 2017). Conservation has a positive impact on several species (Hoffmann et al. 2010) that could be threatened or even become extinct in the near future (Butchart et al. 2006; Hoffmann et al. 2015). Italy has a rich natural heritage and is at the heart of the Mediterranean Basin, one of the most threatened global biodiversity hotspots, due to a high rate of endemism and strong human impact (Médail 2017; Orsenigo et al. 2018).

In-situ and *ex-situ* conservation measures, achieved *via* several techniques, are employed to conserve genetic diversity (Engelmann and Engels 2002). Among plant conservation strategies, the *in-situ* one has, as its primary focus, the conservation of biological diversity and endeavours to manage and conserve species in their natural habitat; indeed, *in-situ* conservation of ecosystems may offer distinct advantages for many plant species by preserving both genetic and ecological information (Hamilton 1994). *Ex-situ* conservation aims to conserve components of biological diversity outside their natural habitats, while complementing *in-situ* activities, and supporting species recovery (Cochrane et al. 2007).

In-situ conservation is entrusted to protected areas, such as National Parks. Italy counts 24 National Parks, which represent the maximum level of habitat protection according to the Italian legislation; this level equals Category II of protected areas in the IUCN classification (Dudley 2008).

The *ex-situ* techniques can guarantee the conservation of the genetic variability of the germplasm (seeds, pollen, plant parts, spores, etc.) and, therefore, the reproduction of the species to be conserved. This type of conservation is managed mostly by seed banks and botanic gardens (Mounce et al. 2017), *Ex-situ* conservation also plays a crucial role in making available plant materials of certified origin for restocking and land management. Loss of biodiversity due to anthropogenic pressures, such as loss and degradation of habitats, climate change, and spread of invasive species cannot be controlled only by *ex-situ* conservation measures. For this reason, an effective conservation strategy must integrate several conservation methods, this approach being called integrated conservation (McGowan et al. 2017; Piotto et al. 2010). It combines *in-situ* conservation, especially within the Protected Areas, with the *ex-situ* conservation. The Convention on Biological Diversity, in two articles (8, 9), underlines and promotes the importance of integrated approaches that combine several conservation practices (Scarascia-Mugnozza and Perrino 2002).

This study aims to highlight the role of the Majella National Park (MNP) in coordinating integrated *in-situ*/*ex-situ* strategies aimed at the preservation of the natural heritage of the Majella massif and its surroundings. In this context, the Majella Seed Bank (MSB) is a significant player in *ex-situ* conservation.

The Majella massif is a Mediterranean mountain, and this area is considered one of the most threatened in Europe (Gomez-Campo 1985). Predictions of climate change indicate that this genetic, floristic, and community diversity could be significantly affected in the future (Jump and Penuelas 2005; Thuiller et al. 2005; Di Musciano et al. 2020). In the Mediterranean mountains, increasing aridity is the major driver of species loss (Pauli et al. 2012). This trend is likely to continue during the coming decades, insofar as climate models

predict increasing temperatures, decreasing annual precipitation, and an expansion of the dry season in southern Europe (Benito et al. 2011). Due to the high degree of endemism and endangered species in these regions, these mountains have a high risk of biodiversity loss. Greater efforts should be addressed to improve the conservation strategies for Mediterranean mountain species. The survival of these endemic and threatened species requires different and complementary conservation approaches and techniques (Raven 2004).

The territory of the MNP has an extraordinarily rich heritage in terms of biodiversity. Protection and management need to be ensured through diversified and interdependent approaches. The MNP has developed an integrated *in-situ*/*ex-situ* conservation strategies following the conservation actions already conducted in the area since the 1970s *ex-situ*. The "Michele Tenore" Botanical Garden has been carrying out several conservation actions, including management of the *index seminum* since the mid-990s. This action has encouraged the development of conservation strategies integrating scientific and management approaches. The *ex-situ* conservation structures currently run by the Park (the MSB, 'Michele Tenore' and 'Daniela Brescia' botanical gardens, and the nursery) are, thus, the result of a process that has taken place over time and that has encouraged concrete actions to protect and increase awareness in decision makers of the importance of identifying *ex-situ* conservation as a key instrument in support of the institutional objectives for managing protected areas.

In this work, we present the integrated conservation strategy of plant biodiversity set up by the MNP, following state-of-the-art techniques, to preserve its extraordinary natural heritage.

Materials and methods

Study area

The MNP, located in the central Apennines, Italy (Fig. 1), was established in 1995 by National Law 1991, n. 394, to preserve, protect and enhance the high value of the inherent natural, historical, and cultural resources of the area. The Park consists mainly of carbonate mountains, separated by valleys and karst high plateaus, with a broad altitudinal range (130–2,793 m a.s.l.). The Majella massif has more than 60 peaks, with half of them rising above 2,000 m, and includes the second highest peak in the Apennines, Mount Amaro (2,793 m). The landscape is dominated by NW-SE-oriented limestone ridges reaching above the beech tree-line, i.e., Morrone, Rotella, Pizzalto, and Porrarra, and by the Majella massif. These mountains are composed almost exclusively of deep layers of limestone where all the geological eras from the Triassic onwards are represented. A unique periglacial plateau at ca. 2000 m lies above the Majella massif and includes more than 15 smooth summits (Whitehead 1951; Stanisci et al. 2011). The Apennines were repeatedly glaciated during the Pleistocene (Giraudi 2005), while simultaneously the Adriatic Sea retreated resulting in the formation of a broad periglacial plain. During the last glacial maximum, the upper part of the massif was covered by a thick ice layer 30 km^2 wide and more than 200 m thick (Jaurand 1994), with

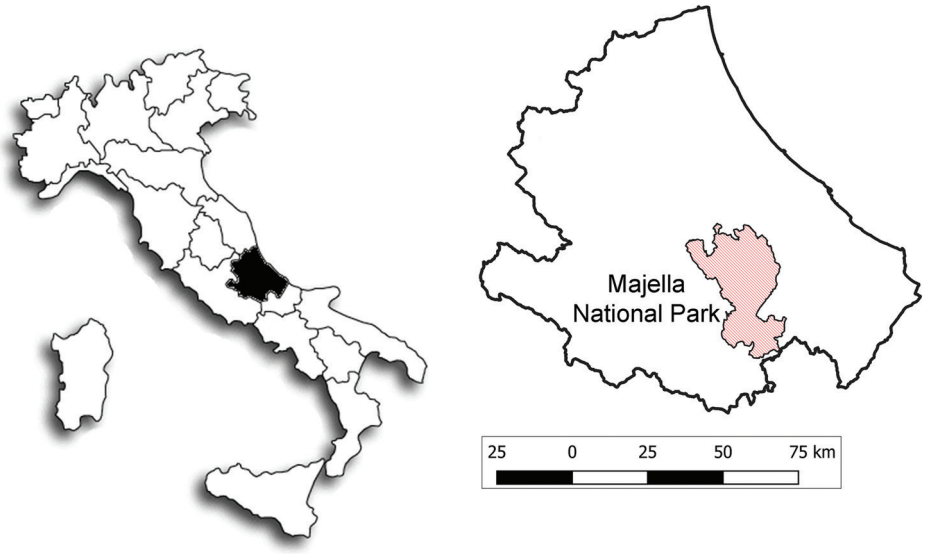

Figure 1. Geographical position of the Majella National Park.

glacial tongues spreading over all the adjacent valleys down to 1330/1400 m of altitude. The Würm glaciation gave origin to macroscopic forms of erosion, circles and moraine deposits; the current periglacial landscape is exposed to frost wedging and long-term snow persistence (7–8 months a year; Stanisci et al. 2005). From a bioclimatic point of view, the study area is included in the alpine biogeographical region (Cervellini et al. 2020) and the climate corresponds to the subalpine-alpine humid type as far as the lower summit is concerned, whereas the other summits belong to the alpine humid type (Blasi 2005). Sub-Mediterranean conditions prevail up to ≈ 1000 m a.s.l. (van Gils et al. 2012). The landscape below 1000 m is a patchwork of villages, farmlands, oak forest fragments (*Quercus pubescens* Willd. subsp. *pubescens*), and shrubs. At mid-elevation (ca. 1000–1750 m), the territory is dominated by contiguous monospecific beech (*Fagus sylvatica* L. subsp. *sylvatica*) forests (van Gils et al. 2010). Secondary montane grasslands, currently unutilized, prevail on south-eastern to south-western slopes. Summer pastoralism above the beech tree-line has been gradually abandoned over the past century.

The Park' territories are part of the Natura 2000 network. The boundaries coincide with a Special Protection Area (SPA) for the conservation of wild birds (established by the Birds Directive 79/409/EEC). Furthermore, within the Park, there are four Special Areas of Conservation (SAC), established by Habitat Directive 92/43/EEC.

The MNP is extremely rich in plant species, indeed its flora stands out for the high number of specific and subspecific taxa, for a total of 2,286 (Conti et al. 2019), including 15 exclusive endemics, such as *Pinguicula fiorii* Tammaro & Pace, *Soldanella minima* Hoppe subsp. *samnitica* Cristof. & Pignatti, *Aquilegia magellensis* F.Conti & Soldano, *Centaurea tenoreana* Willk., *Crepis magellensis* F.Conti & Uzunov. Italian endemic taxa are 201 (8.8%), grouped in 104 genera and 35 families (Conti et al. 2019).

Moreover, the MNP is the *locus classicus* for 49 species and subspecies (Peruzzi et al. 2015, 2019). The Park administration established and maintains two botanical gardens, a seed bank, and a herbarium for preserving and studying the flora of the Park (Di Martino et al. 2016a).

Measures to protect plant biodiversity: Botanical Gardens and Seed Bank

For the *ex-situ* conservation of plant biodiversity, in implementation of art. 9 of the Rio de Janeiro Convention on Biological Diversity, the Park Authority manages two botanical gardens (the "Michele Tenore" at Lama dei Peligni and the "Daniela Brescia" at Sant'Eufemia a Maiella) and the Majella Seed Bank (MSB). These structures aim to collect, study, and conserve seeds of wild species to preserve their genetic heritage.

The "Michele Tenore" Botanical Garden was created in 1995 and currently covers an area of 9,000 m^2. It harbours 433 plant species and is dedicated to the Neapolitan botanist Michele Tenore who visited the area in 1831 and described several species. The "Daniela Brescia" Botanical Garden is located at 900 m a.s.l. in the MNP. It was set up in 2001 and currently includes 545 plant species over a surface area of more than 40,000 m^2. The Garden was designed to contain reproductions of some mountain environments of the central Apennines, like high-altitude cliffs and screes , while an area is dedicated to demonstrative didactic sections, such as the field-showcase of agricultural biodiversity.

The MSB is situated in the "Michele Tenore" Botanical Garden. Its main aim is to preserve particularly rare and/or endangered wild or cultivated species. Seed banks are generally considered a strong and effective tool for long-term biodiversity conservation (Williams et al. 2003; Mattana et al. 2005) and an important potential seed source for the restoration of plant communities (Bakker and Berendse 1999). Furthermore, the ability to store a large diversity in a small space makes seed banking a practical and attractive tool for plant conservation (Liu et al. 2018).

The MSB was established in 2005 to mark the founding of R.I.B.E.S., the Italian Germplasm Bank Network (Rossi et al. 2006; Bonomi et al. 2008), whose founding members include the Park and 15 seed banks throughout Italy. Currently, the MSB is a reference at a Regional level and is a tangible example of the interaction between *ex-situ* and *in-situ* conservation, in the context of Italian national parks. The work of the MSB is inspired by specific international conservation conventions and strategies (Convention on Biological Diversity, CBD 1992; Global Strategy for Plant Conservation GSPC 2012; European Plant Conservation Strategy, EPCS 2002). The MSB *ex-situ* conservation activities mainly focus on rare and/or endangered or endemic alpine belt species, many of which are in the IUCN lists and/or protected by international conventions (Cites, Bern, etc.), the European Community "Habitat" Directive 43/92, Regional Law no. 45/1979 for the protection of Flora in Abruzzo and Red Lists of Italian Plants (Rossi et al. 2013; Orsenigo et al. 2018, 2020). Furthermore, activities relating to restocking projects on plant species included in annex II of the Habitats Directive are underway. The fact that the MSB is managed by a national park is a unique case in Italy.

The Botanical Garden at Sant'Eufemia a Maiella also incorporates the "Native Plants Nursery", aimed exclusively at reproducing (from seed or cuttings) native plant species, particularly the most endangered ones, and/or growing plants for use in the Botanical Gardens or the Park itself. Since 2011, the Sant'Eufemia nursery has been authorised to operate as a commercial nursery (pursuant to D.Lgs 214/2005) and is officially registered in the Producers' Register. In this nursery, 140 species are grown, including perennial herbs, shrubs, trees, and medicinal plants. The nursery's high-quality native plant production is a valid support for public administrations and other public and private botanical gardens (Di Martino et al. 2020).

The Sant'Eufemia Botanical Garden hosts the herbarium which, to date, boasts more than 3,000 specimens, including the critical groups and most endangered species of the Majella massif.

The Park is the coordinator for the FLORANET project, together with the Apennine Flora Research Centre, Legambiente, and other protected areas in Abruzzo. As part of the European Union's LIFE programme, this project aims to preserve the plant species in annex II of the European Directive 43/92/EEC, the "Habitats Directive" (Di Martino et al. 2016a).

Several research activities carried out by the Park support specific *in-situ* conservation measures: management plans for the Natura 2000 sites, monitoring of exclusive endemic flora, a census of monumental trees, monitoring natural populations of native *Pinus nigra* J.F.Arnold subsp. *nigra* var. *italica* Hochst. and *Betula pendula* Roth, and controlling the spread of the invasive alien species *Senecio inaequidens* DC.

Results and discussion

The gardens, the seed bank, the nurseries and the herbarium play an active and integrated role for *in-situ* and *ex-situ* conservation. The cultivated taxa present in the national Red Lists, cultivated endemics, and, finally, all the species stored in the MSB are listed below.

Botanical gardens

The plants grown in the Garden's nursery can be used to (i) reintroduce species that are extinct in the protected areas, (ii) limit the collection of material from the wild in order to maintain the Garden's own collection; (iii) reinforce very small populations of rare species, thereby improving their chances of survival; (iv) encourage the use of native plants for ornamental purposes; (v) encourage the cultivation of native medicinal herbs and traditional fruit trees, thus boosting the use of local species or ecotypes to restore and improve degraded environments.

In Table 1, Red List taxa cultivated in the Botanical Gardens of the MNP are listed, divided by conservation status. At present, nine threatened taxa (CR, EN) and ten Near Threatened (NT) taxa are being cultivated.

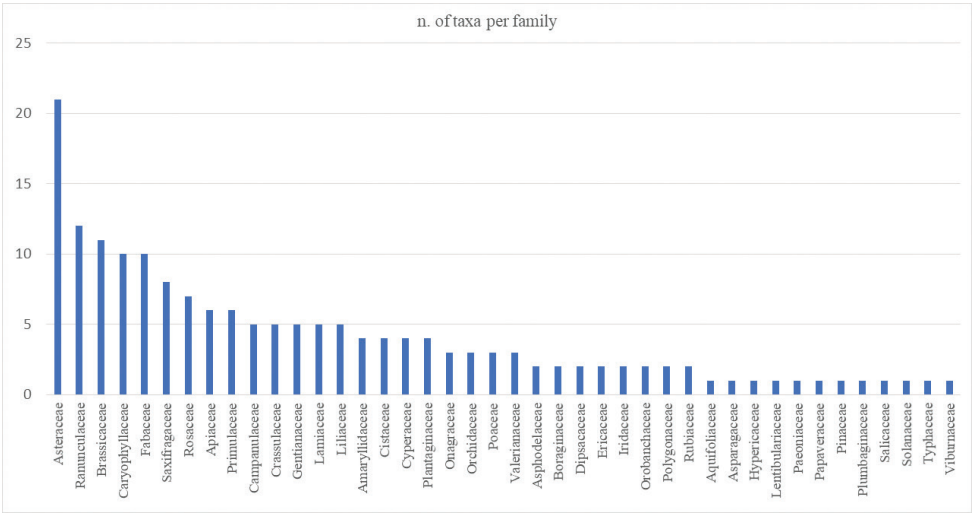

Figure 2. Number of species and subspecies per family stored in the Majella Seed Bank.

A list of endemic taxa cultivated in the two Botanical Gardens is reported in Table 2.

Currently, 52 endemic taxa are being cultivated in the Botanical Gardens, while 226 accessions of wild species are preserved for long-term storage; they were collected over a period of 15 years (from 2005 to 2019). Figure 2 shows the 171 different taxa (species and subspecies) stored in the MSB divided into families. The results highlight the achievement of target 8 for the percentage of species available for restocking, but the Park plans to reach the goal of 75% of the threatened species in the near future.

The most represented families are Asteraceae with 21 taxa, Ranunculaceae with 12, Brassicaceae with 11, Caryophyllaceae and Fabaceae with 10 taxa. Forty-nine taxa are included in the Italian Red List (Rossi et al. 2013, Orsenigo et al. 2018, 2020), and among them, two are Critically endangered (CR): *Bubon macedonicum* L. and *Genista pulchella* Vis. subsp. *aquilana* F.Conti & Manzi; four are Endangered (EN): *Adonis distorta* Ten., *Astragalus aquilanus* Anzal., *Typha minima* Funk ex Hoppe, and *Pinguicula fiorii* Tammaro & Pace; one is Vulnerable (VU): *Oxytropis ocrensis* F.Conti & Bartolucci; 11 are Near Threatened (NT): *Aquilegia magellensis* F.Conti & Soldano, *Carex microcarpa* Bertol. ex Moris, *Crepis magellensis* F.Conti & Uzunov, *Fritillaria montana* Hoppe ex W.D.J.Koch, *Gentiana lutea* L. subsp. *lutea*, *Iris marsica* I.Ricci & Colas., *Jacobaea vulgaris* subsp. *gotlandica* (Neuman) B.Nord., *Leontopodium nivale* (Ten.) Huet ex Hand.-Mazz., *Phyllolepidum rupestre* (Sweet) Trinajstić, *Saxifraga italica* D.A.Webb, *Soldanella minima* Hoppe subsp. *samnitica* Cristof. & Pignatti; 28 are Least Concern (LC); three are Data Deficient (DD).

Five taxa are listed in annex II of the Habitats Directive (1992) in Majella and they are stored in the seed bank (each with a Natura 2000 species code): *Adonis distorta* Ten. (1479), *Androsace mathildae* Levier (1630), *Astragalus aquilanus* Anzal. (priority – 1558), *Cypripedium calceolus* L. (1902), *Himantoglossum adriaticum* H.Baumann (4104). These five species are all present in the directive of the Park's territory, therefore 100% of the

Table 1. Species included in the updated national Red Lists and cultivated in the Botanical Gardens of the Majella National Park. DB – "Daniela Brescia" Botanical Garden; MT – "Michele Tenore" Botanical Garden.

Family	Species	Status IUCN (Rossi et al.2013; Orsenigo et al.2018, 2020)	Botanical Garden
Sapindaceae	*Acer cappadocicum* Gled. subsp. *lobelii* (Ten.) A.E.Murray	LC	DB,MT
Ranunculaceae	*Adonis vernalis* L.	EN	MT
Amaryllidaceae	*Allium commutatum* Guss.	LC	MT
Primulaceae	*Androsace mathildae* Levier	LC	DB
Ranunculaceae	*Aquilegia magellensis* F.Conti & Soldano	NT	DB, MT
Fabaceae	*Astragalus aquilanus* Anzal.	EN	DB, MT
Brassicaceae	*Aubrieta columnae* Guss. subsp. *columnae*	NT	DB, MT
Apiaceae	*Bubon macedonicum* L.	CR	MT
Campanulaceae	*Campanula fragilis* Cirillo subsp. *cavolinii* (Ten.) Damboldt	LC	DB, MT
Cyperaceae	*Carex buxbaumii* Wahlenb.	EN	DB
Asteraceae	*Centaurea scannensis* Anzal., Soldano & F.Conti	EN	DB, MT
Asteraceae	*Centaurea tenoreana* Willk.	LC	DB, MT
Plantaginaceae	*Cymbalaria pallida* (Ten.) Wettst.	LC	DB, MT
Caryophyllaceae	*Dianthus guliae* Janka	EN	DB
Orchidaceae	*Epipactis palustris* (L.) Crantz	NT	DB
Amaryllidaceae	*Galanthus nivalis* L.	LC	DB
Gentianaceae	*Gentiana lutea* L. subsp. *lutea*	NT	DB, MT
Plumbaginaceae	*Goniolimon italicum* Tammaro, Pignatti & Frizzi	EN	MT
Iridaceae	*Iris marsica* I. Ricci & Colas.	NT	DB, MT
Asteraceae	*Klasea lycopifolia* (Vill.) Á.Löve & D.Löve	NT	DB, MT
Asteraceae	*Leucanthemum coronopifolium* Vill. subsp. *tenuifolium* (Guss.) Vogt & Greuter	LC	DB, MT
Brassicaceae	*Phyllolepidum rupestre* (Sweet) Trinajstić	NT	DB, MT
Asparagaceae	*Ruscus aculeatus* L.	NT	DB
Salicaceae	*Salix pentandra* L.	EN	DB, MT
Saxifragaceae	*Saxifraga porophylla* Bertol. subsp. *porophylla*	LC	DB, MT
Poaceae	*Sesleria juncifolia* Wulfen ex Suffren subsp. *juncifolia*	LC	MT
Primulaceae	*Soldanella minima* Hoppe subsp. *samnitica* Cristof. & Pignatti	NT	DB
Typhaceae	*Typha minima* Funk ex Hoppe	EN	MT
Lentibulariaceae	*Utricularia australis* R.Br.	NT	MT

species listed in annex II are preserved in the seed bank. Amongst these, *Astragalus aquilanus* and *Androsace mathildae* are narrow endemics to the Abruzzo Region, *Adonis distorta* is endemic to the central Apennines, while the two Orchidaceae, although extremely localized (especially *Cypripedium calceolus*), show a wider distribution.

During the past years, many species have been studied and several scientific articles published by the seed bank working group; these were inherent to the ecology of germination, the morphometry of seeds, seed dispersal mechanisms, etc. (Frattaroli et al. 2013; Di Martino et al. 2014, 2015; Di Cecco et al. 2017a, 2017c, 2018, 2019; Di Musciano et al. 2018).

These studies are carried out in order to support the preservation of plant germplasm and *in-situ* conservation activities. One of the main projects undertaken by the MSB is the EU-funded Life Floranet that aims to preserve species and ecosystems within the Natura 2000 network (Di Martino et al. 2016a). For this project, which

Table 2. List of Italian endemic taxa (Peruzzi et al. 2014; Bartolucci et al. 2018) cultivated in the Botanical Gardens of the Majella National Park. DB – "Daniela Brescia" Botanical Garden; MT – "Michele Tenore" Botanical Garden. In boldface endemic taxa of the central Apennines.

Family	Endemic species (Peruzzi et al. 2014; Bartolucci et al. 2018)	Botanical Garden
Sapindaceae	*Acer cappadocicum* Gled. subsp. *lobelii* (Ten.) A.E.Murray	DB, MT
Asteraceae	***Achillea barrelieri* (Ten.) Sch.Bip. subsp. *barrelieri***	DB
Asteraceae	*Achillea tenorei* Grande	DB, MT
Brassicaceae	***Alyssum cuneifolium* Ten.**	DB
Brassicaceae	*Alyssum diffusum* Ten. subsp. *diffusum*	DB
Primulaceae	***Androsace mathildae* Levier**	DB
Primulaceae	***Androsace vitaliana* (L.) Lapeyr. subsp. *praetutiana* (Buser ex Sünd.) Kress**	DB
Asteraceae	***Anthemis cretica* L. subsp. *petraea* (Ten.) Greuter**	DB
Ranunculaceae	***Aquilegia magellensis* F.Conti & Soldano**	DB, MT
Caryophyllaceae	*Arenaria bertolonii* Fiori	MT
Plumbaginaceae	*Armeria gracilis* Ten. subsp. *gracilis*	DB
Fabaceae	***Astragalus aquilanus* Anzal.**	DB, MT
Brassicaceae	*Aubrieta columnae* Guss. subsp. *columnae*	DB, MT
Campanulaceae	***Campanula fragilis* Cirillo subsp. *cavolinii* (Ten.) Damboldt**	DB, MT
Asteraceae	*Centaurea ambigua* Guss. subsp. *ambigua*	DB, MT
Asteraceae	***Centaurea ambigua* Guss. subsp. *nigra* (Fiori) Pignatti**	DB
Asteraceae	***Centaurea ceratophylla* Ten. subsp. *ceratophylla***	DB, MT
Asteraceae	***Centaurea scannensis* Anzal., Soldano & F.Conti**	DB, MT
Asteraceae	*Centaurea tenoreana* Willk.	DB, MT
Caryophyllaceae	*Cerastium tomentosum* L.	DB, MT
Rosaceae	*Cotoneaster nebrodensis* (Guss.) K.Koch	MT
Plantaginaceae	***Cymbalaria pallida* (Ten.) Wetts**	DB, MT
Boraginaceae	*Cynoglossum magellense* Ten.	MT
Caryophyllaceae	*Dianthus carthusianorum* L. subsp. *tenorei* (lacaita) Pignatti	DB
Caryophyllaceae	*Dianthus guliae* Janka	DB
Plantaginaceae	*Digitalis micrantha* Roth ex Schweigg.	DB
Brassicaceae	*Erysimum pseudorhaeticum* Polatschek	DB, MT
Euphorbiaceae	***Euphorbia gasparrinii* Boiss. subsp. *samnitica* (Fiori) Pignatti**	DB
Rubiaceae	*Galium lucidum* All. s.l.	DB
Rubiaceae	*Galium magellense* Ten.	DB
Geraniaceae	*Geranium austroapenninum* Aedo	DB
Plumbaginaceae	***Goniolimon italicum* Tammaro, Pignatti & Frizzi**	MT
Iridaceae	***Iris marsica* I. Ricci & Colas.**	DB, MT
Asteraceae	*Jacobaea alpina* (L.) Moench subsp. *samnitum* (Nyman) Peruzzi	DB
Asteraceae	***Leucanthemum coronopifolium* Vill. subsp. *tenuifolium* (Guss.) Vogt & Greuter**	DB, MT
Asteraceae	*Leucanthemum tridactylites* (A.Kern. & Huter ex Porta & Rigo) Huter, Porta & Rigo	DB, MT
Plantaginaceae	*Linaria purpurea* (L.) Mill.	DB
Caprifoliaceae	*Lomelosia crenata* (Cirillo) Greuter & Burdet subsp. *pseudisetensis* (Lacaita) Greuter & Burdet	DB, MT
Caryophyllaceae	*Mcneillia graminifolia* (Ard.) Dillenb. & Kadereit subsp. *rosanoi* (Ten.) F.Conti, Bartolucci, Iamonico & Del Guacchio	DB
Boraginaceae	*Onosma echioides* (L.) L. subsp. *echioides*	DB, MT
Paeoniaceae	***Paeonia officinalis* L. subsp. *italica* N.G.Passal. & Bernardo**	DB, MT
Brassicaceae	***Phyllolepidum rupestre* (Sweet) Trinajstić**	DB, MT
Boraginaceae	*Pulmonaria vallarsae* A.Kern. subsp. *apennina* (Cristof. & Puppi) L.Cecchi & Selvi	DB
Saxifragaceae	***Saxifraga exarata* Vill. subsp. *ampullacea* (Ten.) D.A.Webb**	DB
Saxifragaae	***Saxifraga italica* D.A. Webb**	DB
Saxifragaceae	*Saxifraga oppositifolia* L. s.l.	DB
Saxifragaae	*Saxifraga porophylla* Bertol. subsp. *porophylla*	DB, MT
Crassulaceae	*Sedum magellense* Ten. subsp. *magellense*	DB
Poaceae	*Sesleria nitida* Ten. subsp. *nitida*	DB, MT
Caryophyllaceae	***Silene notarisii* Ces.**	DB, MT
Primulaceae	***Soldanella minima* Hoppe subsp. *samnitica* Cristof. & Pignatti**	DB
Lamiaceae	*Stachys italica* Mill.	DB

Figure 3. Plants of *Iris marsica* grown in the Majella National Park nursery).

is still in progress, 10 restockings has been scheduled, divided by species and action (Table 3). All the plant material used for restocking came from the MSB and the Sant'Eufemia nursery (Figure 3).

The applied strategies of the MNP are essential to perform concrete actions for species conservation. Such actions go from the collection of seeds in nature, *in-vitro* propagation, seed reproduction long-term storage, *in-situ* restocking up to the creation

Table 3. List of species, places of intervention and number of individuals used for restocking actions within the Life Floranet project. MNP – Majella National Park; SVRP – Sirente Velino Regional Park; ALMNP – Abruzzo, Lazio and Molise National Park.

Taxon	Park	Localities	n. of plant
Astragalus aquilanus Anzal.	MNP	Cansano	100
Astragalus aquilanus Anzal.	MNP	Pacentro	100
Astragalus aquilanus Anzal.	ALMNP	Ortona dei Marsi	100
Androsace mathildae Levier	MNP	Pesco Falcone	50
Iris marsica I.Ricci & Colas.	ALMNP	Camosciara	100
Cypripedium calceolus L.	MNP	Valle di Macchialunga	100*
Cypripedium calceolus L.	ALMNP	Camosciara	100*
Jacobaea vulgaris subsp. *gotlandica* (Neuman) B.Nord.	SVRP	Piani di Pezza	100
Jacobaea vulgaris subsp. *gotlandica* (Neuman) B.Nord.	SVRP	Piani di Pezza (laghetto)	100
Klasea lycopifolia (Vill.) Á.Löve & D.Löve	SVRP	Campo Felice	100

* Due to the long growth times, the planned restocking actions will be carried out in the coming years.

of new populations. The functionality and operation of the structures, that are already well established for *ex-situ* conservation, have been tested on restocking actions.

The restocking actions were carried out not only within the boundary of the MNP, but were also extended to other areas of central Italy. In this context, considering that from the 67,620 seed accessions of native plants stored in European seed banks (ENSCOBASE) only 64 (0.09%) were used in translocation programs (Abeli and Dixon 2016), the MNP plays a crucial role in carrying out these strategies and in monitoring endemic or rare species, thereby avoiding the risk of extinction (Dalrymple and Abeli 2019). To date, eight accessions of the MSB have been used for restocking actions. The total number of accessions preserved in MSB is 256, consequently, the percentage of accessions used for restocking is 3.125%, which is significantly higher than the percentage indicated by Abeli and Dixon (2016). Such actions provide exceptionally strong support to the MNP by making use of a truly integrated conservation strategy through the concerted action of its *in-situ* / *ex-situ* facilities.

The amount of seeds stored in the MSB is growing constantly, both in terms of number of species and the area covered. At a Regional level, this represents a way to preserve the genetic resources of both wild species (including trees) and cultivated species of agricultural, culinary, and ornamental interest. The MSB is a landmark in Italy as an example of integration between *ex-situ* and *in-situ* conservation.

The strong effort for *ex-situ* conservation made by the MNP is confirmed by the high number of conserved species. Indeed one-third of the Italian endemic species of the Park (68 species out of 201) and one-third of the species present in the Red Lists (65 species out of 195) are conserved at the Botanical Gardens and in the seed bank. Future collection programmes will be focused on the missing endangered and endemic taxa. The main aim is to achieve the conservation and/or cultivation of at least 75% of the threatened and endemic taxa. This will be done essentially within the Park's territory without, however, excluding species from the Abruzzo Administrative Region and throughout the Apennines.

As regards the agricultural heritage, more than 150 Crop Wild Relatives (CWR; Di Martino et al. 2016c) and 61 native agricultural varieties (Di Santo and Di Cecco 2015) have been identified within the MNP. Conservation plans for the CWR and landraces are made in accordance with the FAO Treaty and the Nagoya International Protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilization as per the convention on biological diversity. Several CWR species are cultivated and conserved in both Botanical Gardens. For both wild and cultivated taxa, in vivo cultivation and reproduction is a fundamental step towards conservation planning within protected areas (Heywood, 2019). On the other hand, seeds are stored in the MSB, also for studies relating to reproductive biology (Di Cecco et al. 2019). For some species, such as *Secale strictum* (C.Presl) C.Presl subsp. *strictum*, *Apium graveolens* L., and some species of *Lathyrus*, the number of individuals, and the status of populations are being monitored. Moreover, germination tests were carried out to increase knowledge about seed storage and germination niche (Di Cecco et al. 2017b).

The seed bank also stores seed from native local landraces recovered as part of the "Let's Grow Diversity" project. Conserving these landraces is important because they are the result of a long, balanced co-evolution over centuries between Man and nature (Hawkes et al. 2012). The most significant landraces include "Solina" and "Marzuolo" wheats and "Caffè" and "Socere e Nore" beans.

All these actions suggest as an integrated strategy from the seed bank to field cultivation and restoking action is crucial for biodiversity conservation. Furthermore, the collaborations with other botanical gardens and germplasm banks are always desirable to exchange knowledge, procedures, and techniques and duplicate collections.

Conclusions

Cooperation among the structures of the Park (botanical gardens, seed bank, herbarium, and nursery) allows the development of complete conservation programmes, from collection, study, reproduction, cultivation to *in-situ* restocking. Meanwhile, the contribution of the *ex-situ* structures is important for achieving the aims of a National Park. In particular, as indicated by Italian legislation (Law 394/91) on protected areas, we have developed conservation plans for plant species and promoted educational and scientific research activities. In conclusion, the MNP's conservation activities have proved to be effective, as demonstrated by the restocking actions undertaken for the Life FLORANET project. In particular, the seed bank has proved to be extremely useful for studies on germination ecology of rare taxa. In the coming years, the MSB will certainly increase the number of accessions (Table 4), thus guaranteeing greater efficiency in safeguarding rare, endemic and threatened taxa.

At present, 33.3% of the MNP's species present in the Red List are stored in the MSB. For the endemic taxa, 40 are stored in the MSB (33.8% of the endemic species of the Park).

Table 4. List of taxa stored at the Majella Seed Bank. The nomenclature and the systematic order of the families follows the updated checklists of the vascular flora native and alien to Italy (Bartolucci et al. 2018; Galasso et al. 2018). Taxa are ordered alphabetically within each family. For each taxon, the accepted name, main synonyms, and the Italian endemic or alien status are also reported. Abbreviations or symbols used in the floristic list preceding species/subspecies name are: Distribution: Italian endemic taxa, including Malta and Corsica (Peruzzi et al. 2014; Bartolucci et al. 2018): "E"; Taxa narrowly endemic to the Maiella National Park (Conti et al. 2019): "EE"; Cryptogenic (status at the national level, see Bartolucci et al. 2018): "C", a doubtfully native taxon, whose origin of occurrence in Italy is unknown; Archaeophyte (status at the national level, see Galasso et al. 2018): "A"; The IUCN status is indicated according to the following publications: Lista Rossa della Flora Italiana. 1. Policy Species e altre specie minacciate (Rossi et al. 2013); Red Listing plants under full national responsibility: extinction risks and threats in the vascular flora endemic to Italy (Orsenigo et al. 2018); Red list of threatened vascular plants in Italy (Orsenigo et al. 2020). The accessions of local agronomic landraces are shown at the end of the table.

Family	Species name	Distribution	Red list of threatened plants in Italy (2020)	Red list of threatened vascular plants in Italy (2018)	Italian Red List (2013)
Amaryllidaceae	*Allium commutatum* Guss.		LC		
Amaryllidaceae	*Allium lusitanicum* Lam.				
Amaryllidaceae	*Allium oleraceum* L. subsp. *oleraceum*				
Amaryllidaceae	*Allium sphaerocephalon* L. subsp. *sphaerocephalon*				
Apiaceae	*Bubon macedonicum* L.		CR		CR
Apiaceae	*Coristospermum cuneifolium* (Guss.) Bertol.	E		LC	
Apiaceae	*Crithmum maritimum* L.				
Apiaceae	*Siler montanum* Crantz subsp. *siculum* (Spreng.) Iamonico, Bartolucci & F.Conti	E		LC	
Apiaceae	*Trinia dalechampii* (Ten.) Janch.				
Aquifoliaceae	*Ilex aquifolium* L.				
Asparagaceae	*Muscari neglectum* Guss. ex Ten.				
Asphodelaceae	*Asphodeline lutea* (L.) Rchb.				
Asphodelaceae	*Asphodelus macrocarpus* Parl. subsp. *macrocarpus*				
Asteraceae	*Achillea barrelieri* (Ten.) Sch. Bip. subsp. *barrelieri*	E		LC	
Asteraceae	*Achillea tenorei* Grande	E		LC	
Asteraceae	*Artemisia eriantha* Ten.				
Asteraceae	*Carduus chrysacanthus* Ten.				
Asteraceae	*Centaurea ceratophylla* Ten. subsp. *ceratophylla*	E		LC	
Asteraceae	*Centaurea tenoreana* Willk.	EE		LC	
Asteraceae	*Crepis magellensis* F. Conti & Uzunov	EE		NT	
Asteraceae	*Crepis pygmaea* L.				
Asteraceae	*Doronicum columnae* Ten.				
Asteraceae	*Erigeron epiroticus* (Vierh.) Halácsy				
Asteraceae	*Eupatorium cannabinum* L. subsp. *cannabinum*				
Asteraceae	*Helichrysum italicum* (Roth) G.Don subsp. *italicum*				

Family	Species name	Distribution	Red list of threatened plants in Italy (2020)	Red list of threatened vascular plants in Italy (2018)	Italian Red List (2013)
Asteraceae	*Jacobaea alpina* (L.) Moench subsp. *samnitum* (Nyman) Peruzzi	E		LC	
Asteraceae	*Jacobaea vulgaris* subsp. *gotlandica* (Neuman) B. Nord.		NT		
Asteraceae	*Jurinea mollis* (L.) Rchb. subsp. *mollis*				
Asteraceae	*Klasea lycopifolia* (Vill.) Á.Löve & D.Löve				
Asteraceae	*Leontopodium nivale* (Ten.) Huet ex Hand.-Mazz.		NT		
Asteraceae	*Mycelis muralis* (L.) Dumort.				
Asteraceae	*Omalotheca diminuta* (Braun-Blanq.) Bartolucci & Galasso				
Asteraceae	*Scorzoneroides montana* (Lam.) Holub subsp. *breviscapa* (DC.) Greuter	E		LC	
Asteraceae	*Tragopogon porrifolius* L.				
Boraginaceae	*Cynoglossum magellense* Ten.	E		LC	
Boraginaceae	*Myosotis graui* Selvi	E		LC	
Brassicaceae	*Alyssum cuneifolium* Ten.	E			
Brassicaceae	*Alyssum diffusum* Ten. subsp. *diffusum*	E		LC	
Brassicaceae	*Arabis alpina* L. subsp. *caucasica* (Willd.) Briq.				
Brassicaceae	*Aurinia sinuata* (L.) Griseb.				
Brassicaceae	*Draba aizoides* L. subsp. *aizoides*				
Brassicaceae	*Iberis saxatilis* L. subsp. *saxatilis*				
Brassicaceae	*Isatis apennina* Ten. ex Grande				
Brassicaceae	*Isatis tinctoria* L. subsp. *tinctoria*	A			
Brassicaceae	*Matthiola incana* (L.) W.T:Aiton subsp. *incana*				
Brassicaceae	*Noccaea stylosa* (Ten.) Rchb.	E		LC	
Brassicaceae	*Phyllolepidum rupestre* (Sweet) Trinajstić	E		NT	
Campanulaceae	*Campanula fragilis* Cirillo subsp. *cavolinii* (Ten.) Damboldt	E		LC	
Campanulaceae	*Campanula rapunculus* L.				
Campanulaceae	*Campanula scheuchzeri* Vill. subsp. *scheuchzeri*				
Campanulaceae	*Campanula trachelium* L. subsp. *trachelium*				
Campanulaceae	*Edraianthus graminifolius* (L.) A.DC. subsp. *graminifolius*				
Caryophyllaceae	*Arenaria bertolonii* Fiori	E	LC		
Caryophyllaceae	*Arenaria grandiflora* L. subsp. *grandiflora*				
Caryophyllaceae	*Cerastium thomasii* Ten.	E		LC	
Caryophyllaceae	*Cerastium tomentosum* L.	E		LC	
Caryophyllaceae	*Drypis spinosa* L. subsp. *spinosa*				
Caryophyllaceae	*Heliosperma pusillum* (Waldst. & Kit.) Rchb. subsp. *pusillum*				

Family	Species name	Distribution	Red list of threatened plants in Italy (2020)	Red list of threatened vascular plants in Italy (2018)	Italian Red List (2013)
Caryophyllaceae	*Sabulina verna* (L.) Rchb. subsp. *verna*				
Caryophyllaceae	*Silene acaulis* (L.) Jacq. subsp. *bryoides* (Jord.) Nyman				
Caryophyllaceae	*Silene ciliata* Pourr. subsp. *graefferi* (Guss.) Nyman				
Caryophyllaceae	*Silene notarisii* Ces.	E		DD	
Cistaceae	*Cistus creticus* L. subsp. *creticus*				
Cistaceae	*Cistus creticus* L. subsp. *eriocephalus* (Viv.) Greuter & Burdet				
Cistaceae	*Fumana ericifolia* Wallr.				
Cistaceae	*Helianthemum nummularium* (L.) Mill. subsp. *obscurum* (Čelak.) Holub				
Crassulaceae	*Petrosedum rupestre* (L.) P.V.Heath				
Crassulaceae	*Sedum album* L. subsp. *micranthum* (Bast. ex DC.) Syme				
Crassulaceae	*Sedum atratum* L.				
Crassulaceae	*Sedum dasyphyllum* L. subsp. *dasyphyllum*				
Crassulaceae	*Umbilicus horizontalis* (Guss.) DC.				
Cyperaceae	*Carex kitaibeliana* Degen ex Bech.				
Cyperaceae	*Carex microcarpa* Bertol. ex Moris	E	NT		
Cyperaceae	*Carex myosuroides* Vill.				
Cyperaceae	*Eriophorum latifolium* Hoppe				
Dipsacaceae	*Lomelosia crenata* (Cirillo) Greuter & Burdet subsp. *pseudisetensis* (Lacaita) Greuter & Burdet	E		LC	
Dipsacaceae	*Lomelosia graminifolia* (L.) Greuter & Burdet subsp. *graminifolia*				
Ericaceae	*Arctostaphylos uva-ursi* (L.) Spreng.				
Ericaceae	*Orthilia secunda* (L.) House				
Fabaceae	*Anthyllis montana* L. subsp. *jacquinii* (Rchb.f.) Rohlena				
Fabaceae	*Astragalus aquilanus* Anzal.	E		EN	EN
Fabaceae	*Coronilla valentina* L.				
Fabaceae	*Genista pulchella* Vis. subsp. *aquilana* F. Conti & Manzi	E			CR
Fabaceae	*Lathyrus clymenum* L.				
Fabaceae	*Lathyrus odoratus* L.	E		LC	
Fabaceae	*Lathyrus oleraceus* Lam.				
Fabaceae	*Ononis rotundifolia* L.				
Fabaceae	*Oxytropis ocrensis* F. Conti & Bartolucci	E		VU*	
Fabaceae	*Trifolium thalii* Vill.				
Gentianaceae	*Gentiana cruciata* L. subsp. *cruciata*				
Gentianaceae	*Gentiana dinarica* Beck				
Gentianaceae	*Gentiana lutea* L. subsp. *lutea*				NT

Family	Species name	Distribution	Red list of threatened plants in Italy (2020)	Red list of threatened vascular plants in Italy (2018)	Italian Red List (2013)
Gentianaceae	*Gentiana orbicularis* Schur				
Gentianaceae	*Gentiana verna* L. subsp. *verna*				
Hypericaceae	*Hypericum richeri* Vill. subsp. *richeri*				
Iridaceae	*Chamaeiris lorea* (Janka) Peruzzi, F.Conti & Bartolucci				
Iridaceae	*Iris marsica* I. Ricci & Colas.	E		NT	NT
Lamiaceae	*Melissa officinalis* L. subsp. *officinalis*	C			
Lamiaceae	*Phlomis fruticosa* L.				
Lamiaceae	*Salvia officinalis* L. subsp. *officinalis*				
Lamiaceae	*Teucrium flavum* L. subsp. *flavum*				
Lamiaceae	*Thymus zygiformis* Heinr. Braun var. *magellensis* (Ronniger) Bartolucci & J.Walter		DD		
Lentibulariaceae	*Pinguicula fiorii* Tammaro & Pace	EE		EN	
Liliaceae	*Fritillaria montana* Hoppe ex W.D.J.Koch				NT
Liliaceae	*Lilium martagon* L.				
Linaceae	*Linum alpinum* Jacq.				
Linaceae	*Linum usitatissimum* L. subsp. *angustifolium* (Huds.) Thell.				
Linaceae	*Linum viscosum* L.				
Onagraceae	*Chamaenerion angustifolium* (L.) Scop.				
Onagraceae	*Chamaenerion dodonaei* (Vill.) Schur ex Fuss				
Onagraceae	*Epilobium hirsutum* L.				
Orchidaceae	*Cypripedium calceolus* L.				LC
Orchidaceae	*Himantoglossum adriaticum* H.Baumann				LC
Orchidaceae	*Limodorum abortivum* (L.) Sw.				
Orobanchaceae	*Pedicularis hoermanniana* K.Malý				
Orobanchaceae	*Rhinanthus alectorolophus* (Scop.) Pollich subsp. *alectorolophus*				
Paeoniaceae	*Paeonia officinalis* L. subsp. *italica* N.G.Passal. & Bernardo	E		LC	
Papaveraceae	*Papaver alpinum* L. subsp. *alpinum*				
Pinaceae	*Pinus mugo* Turra subsp. *mugo*				
Plantaginaceae	*Erinus alpinus* L.				
Plantaginaceae	*Linaria alpina* (L.) Mill.				
Plantaginaceae	*Plantago atrata* Hoppe subsp. *fuscescens* (Jord.) Pilg.				
Plantaginaceae	*Veronica aphylla* L. subsp. *aphylla*				
Plumbaginaceae	*Armeria gracilis* Ten. subsp. *majellensis* (Boiss.) Arrigoni	E		LC	
Poaceae	*Briza maxima* L.				
Poaceae	*Briza minor* L.				

Family	Species name	Distribution	Red list of threatened plants in Italy (2020)	Red list of threatened vascular plants in Italy (2018)	Italian Red List (2013)
Poaceae	*Secale strictum* (C.Presl) C.Presl subsp. *strictum*				
Polygonaceae	*Bistorta vivipara* (L.) Delarbre				
Polygonaceae	*Rumex arifolius* All.				
Primulaceae	*Androsace mathildae* Levier	E		LC	LC
Primulaceae	*Androsace villosa* L. subsp. *villosa*				
Primulaceae	*Androsace vitaliana* (L.) Lapeyr. subsp. *praetutiana* (Buser ex Sünd.) Kress	E		LC	
Primulaceae	*Primula intricata* Gren. & Godr.				
Primulaceae	*Primula veris* L. subsp. *columnae* (Ten.) Maire & Petitm.				
Primulaceae	*Soldanella minima* Hoppe subsp. *samnitica* Cristof. & Pignatti	EE		NT	
Ranunculaceae	*Actaea spicata* L.				
Ranunculaceae	*Adonis distorta* Ten.	E		EN	EN
Ranunculaceae	*Aquilegia dumeticola*Jord.				
Ranunculaceae	*Aquilegia magellensis* F. Conti & Soldano	EE		NT	
Ranunculaceae	*Clematis vitalba* L.				
Ranunculaceae	*Pulsatilla alpina* (L.) Delarbre subsp. *millefoliata* (Bertol.) D.M.Moser				
Ranunculaceae	*Pulsatilla montana* (Hoppe) Rchb. subsp. *montana*				
Ranunculaceae	*Ranunculus magellensis* Ten.	E		DD	
Ranunculaceae	*Ranunculus seguieri* Vill. subsp. *seguieri*				
Ranunculaceae	*Thalictrum aquilegiifolium* L. subsp. *aquilegiifolium*				
Ranunculaceae	*Thalictrum simplex* L. subsp. *simplex*				
Ranunculaceae	*Trollius europaeus* L.				
Rosaceae	*Dryas octopetala* L. subsp. *octopetala*				
Rosaceae	*Geum molle* Vis. & Pančić				
Rosaceae	*Potentilla crantzii* (Crantz) Beck ex Fritsch subsp. *crantzii*				
Rosaceae	*Pyracantha coccinea* M.Roem.				
Rosaceae	*Sorbus aria* (L.) Crantz				
Rosaceae	*Sorbus chamaemespilus* (L.) Crantz				
Rosaceae	*Sorbus mougeotii* Soy.-Will. & Godr.				
Rubiaceae	*Galium corrudifolium* Vill.				
Rubiaceae	*Galium magellense* Ten.	E		LC	
Salicaceae	*Salix retusa* L.				
Saxifragaceae	*Saxifraga adscendens* L. subsp. *adscendens*				
Saxifragaceae	*Saxifraga caesia* L.				
Saxifragaceae	*Saxifraga callosa* Sm. subsp. *callosa*				
Saxifragaceae	*Saxifraga exarata* Vill. subsp. *ampullacea* (Ten.) D.A.Webb	E		LC	

Family	Species name	Distribution	Red list of threatened plants in Italy (2020)	Red list of threatened vascular plants in Italy (2018)	Italian Red List (2013)
Saxifragaceae	*Saxifraga italica* D.A.Webb	E		NT	
Saxifragaceae	*Saxifraga oppositifolia* L. subsp. *speciosa* (Dörfl. & Hayek) Engl. & Irmsh.	E		LC	
Saxifragaceae	*Saxifraga paniculata* Mill.				
Saxifragaceae	*Saxifraga rotundifolia* L. subsp. *rotundifolia*				
Solanaceae	*Atropa bella-donna* L.				
Typhaceae	*Typha minima* Funk ex Hoppe				EN
Valerianaceae	*Centranthus ruber* (L.) DC. subsp. *ruber*				
Valerianaceae	*Valeriana montana* L.				
Valerianaceae	*Valeriana saliunca* All.				
Viburnaceae	*Viburnum lantana* L.				

Local agronomic landraces

Family	Species name	Landraces name
Fabaceae	*Phaseolus vulgaris* L.	40 giorni
Fabaceae	*Phaseolus vulgaris* L.	a caffè
Fabaceae	*Phaseolus vulgaris* L.	aquilano
Fabaceae	*Phaseolus vulgaris* L.	socere e nore
Fabaceae	*Vicia faba* L.	mezza fava
Poaceae	*Triticum aestivum* L.	solina
Poaceae	*Triticum aestivum* L.	casorella
Poaceae	*Triticum dicoccon* Schrank	farro del Sangro
Poaceae	*Triticum dicoccon* Schrank	levese
Poaceae	*Triticum durum* Desf.	rosciola
Poaceae	*Triticum durum* Desf.	ruscia
Poaceae	*Triticum durum* Desf.	marzuolo

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Supplementary material 1

Complete list of taxa stored at the MSB

Authors: Valter Di Cecco, Marco Di Santo, Michele Di Musciano, Aurelio Manzi, Mirella Di Cecco, Giampiero Ciaschetti, Giuseppe Marcantonio, Luciano Di Martino

Data type: checklist

Explanation note: List of taxa stored at the Majella Seed Bank. Where present, IUCN status is indicated.

Link: https://doi.org/10.3897/italianbotanist.10.52952.suppl1

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RESEARCH ARTICLE

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Anthyllis cytisoides L. (Fabaceae), new to the Italian native flora

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Abstract

We present the first finding of *Anthyllis cytisoides* L. in Italy. This western Mediterranean woody species was found close to the coastline on the southwest side of Mt. Argentario in southern Tuscany, on limestone rocks within a xerophytic garrigue community of the *Erico multiflorae-Rosmarinetum officinali* association. A description of the plant is given along with an original iconography and photos taken in the field. The reasons for considering this population of natural origin are briefly discussed, along with the possible causes of its wide disjunction from the rest of the species range.

Keywords

disjunct populations, Fabaceae, Italian flora, Leguminosae, mediterranean plants, Tuscan phytogeography

Introduction

The genus *Anthyllis* L. belongs to subfamily Papilionoideae (Legume Phylogeny Working Group 2017) and includes 25 species distributed in Europe, Western Asia and North Africa, southward to Ethiopia (Degtjareva et al. 2012; Mabberley 2017). These species are largely variable in habit and life-cycle, from woody shrubs to perennial, biennial or annual herbs, usually unarmed, rarely spiny. Morphologically, the genus is mostly characterized by the monosperm legume with membranaceous pericarp, enclosed in the calyx. Phylogenetically, it is included in the clade of tribe Loteae and is probably sister to the monotypic African genus *Antopetitia* A.Rich. (Degtjareva et al. 2012).

The Italian flora includes four species, *A. barba-jovis* L., *A. hermanniae* L. (with three subspecies), *A. montana* L., and the taxomically critical group of *A. vulneraria* L. s.l., where some 15 infraspecific taxa have been recognized (Bartolucci et al. 2018).

Anthyllis cytisoides L. is a diploid woody species closely related to *A. terniflora* (Lag.) Pau and belonging to the core group of *Anthyllis* (Benedì 2000; Degtjareva et al. 2012). These two western Mediterranean species are not closely related to the central and Eastern Mediterranean woody species [*A. hermanniae* L. and *A. hystrix* (Willk. ex F.Barceló) Cardona, Contandr. & E.Sierra] and were therefore segregated in the separate subgenus *Terniflora* W.N.Tikhom. & D.D.Sokoloff (Tikhomirov and Sokoloff 1996). This subgenus was then reduced to section by Benedì (1998) in his treatment for *Flora Iberica*.

Based on current information, *A. cytisoides* is native to Nortwestern Africa (Algeria and Morocco), the Iberian peninsula, including the Balearic islands, and southern France (Languedoc-Roussilon and Provence; Benedì 2000; Euro+Med PlantBase; Roskov et al. 2006). To our best knowledge, the species has never been observed in Italy (Bartolucci et al. 2018). During botanical fieldwork in southern Tuscany we discovered a small but presumably native population of this species, which is described here for its phytogeographical relevance.

The new record

***Anthyllis cytisoides* L., Sp. Pl.: 720 (1753)**

Note. Italia, Toscana, Monte Argentario (Grosseto province), rocce calcaree nella garriga bassa a erica multiflora e rosmarino verso La Ciana fra Punta Avoltore e Punta di Torre Ciana (WGS84: 42°22.25'N, 11°09.98'E), 80 m, 23 May 2020, *F. Selvi & I. Bettarini* (Herb. Selvi no. 3975 in FI!).

Description of the plant. Nano-phanerophyte up to 60 cm, much-branched from a woody base; branches erect, unarmed, with whitish indumentum of short appressed hairs. Leaves softly pubescent, the lower mostly unifoliolate, 1.8–2.5 × 0.7–0.9 mm, ovate-lanceolate, apiculate; petiole 8–9 mm long, slightly dilatated at the base and provided with two scale-like stipules of ca. 0.2 mm. Mid-cauline and upper leaves mostly trifoliolate, with central leaflet petiolated, obovate-lanceolate, 1.3–1.8 × 4–6 mm, and lateral leaflets much smaller, 0.5–0.8 × 0.2–0.3 mm, acute at apex. Flowers grouped in 2–4 in subsessile fascicles arranged in a lax spiciform inflorescence up to 20 cm long, each fascicle inserted at the axil of ovate-lanceolate bracts, the lower often divided in two or three segments, pointed at apex, pubescent, nearly as long as long as flowers. Flowers ca. 10 mm, subsessile. Calyx villous-pubescent, tubular, 5–6 × 2–2.5 mm, with slightly obliquous mouth and very narrow teeth, these shorter than tube (2 mm), the upper slightly longer than the lower ones. Corolla yellow, with standard petal ca. 4.2 × 3 mm and wings ca. 1 mm longer than keel. Androecium sub-monoadelphous, with one stamen partially free. Legume 3–4 × 2 mm, monosperm, obovoid, apiculate; seeds 1.2 × 2 mm, reniform and smooth (seeds not seen, data from the literature).

Iconography. Figures 1, 2a,b.

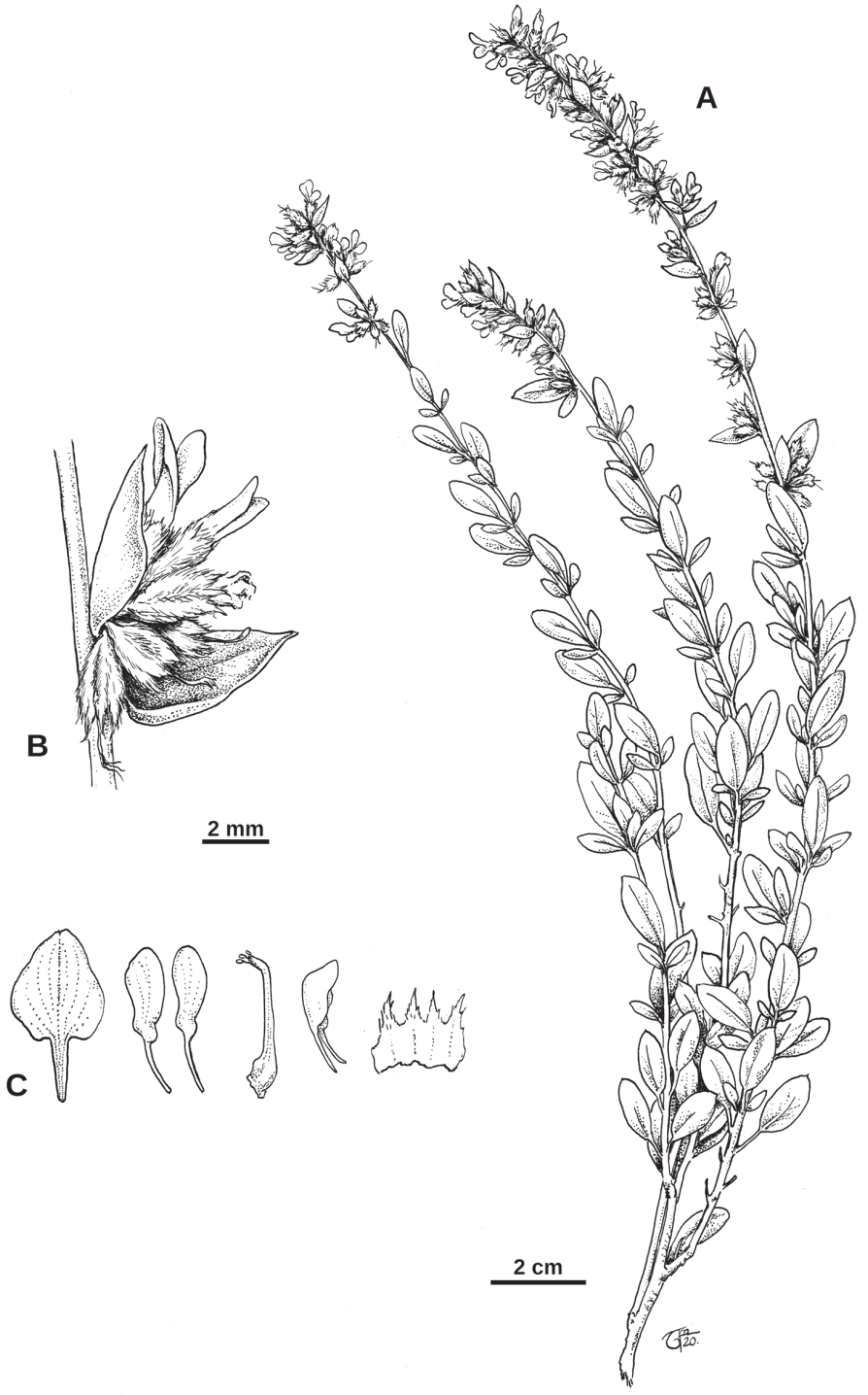

Figure 1. Original drawing of *Anthyllis cytisoides* L. from Mt. Argentario, based on collection *Selvi* 3975 (original artwork by Laura Vivona) **A** branch with leaves and inflorescence **B** single fascicle of flowers with bract **C** dissected flower showing (from the left), standard petal, wings, stamens, keel and calyx teeth.

Figure 2. Whole plant of *Anthyllis cytisoides* in its natural habitat on Mt. Argentario (**A**) and particular of the inflorescence (**B**); photographs by F. Selvi, 23 May 2020.

Locality, habitat and threats. *Anthyllis cytisoides* was found on Mt. Argentario, a former island of the Tuscan Archipelago that became connected to the south Tuscan mainland during the Quaternary age by two sandy isthms (Lazzarotto 1993). The species was observed in a very narrow area (a few hundreds of square meters), at 80 m above the rocky coastline on the southern part of the massif, between Punta di Torre Ciana and Punta Avoltore, close to a steep, narrow valley descending to the sea, called Valle Lunga. The few individuals were growing on outcropping limestone rocks within a typical low garrigue of the *Erico multiflorae-Rosmarinetum officinali* (Horvat.) Trinajstic community. This is typical of the warmest and dryest parts of Mt. Argentario with eroded slopes and rocky calcareous soil (Arrigoni and Di Tommaso 1997). The site was apparently natural, with no signs of recent human disturbance.

No incumbent threats to the population could be be identified. However, its very small size exposes it to any stochastic or unpredictable event that may occur at the site. The main risk is probably collection by unaware people, considering that the plants are easily accessible from a dirt road and close to a panoramic point.

Final remarks. *Anthyllis cytisoides* appears new to the Italian flora, as no literature record exists that can document its presence over the national territory, even in historical times. This is supported by the study of herbarium collections in FI (!) and FIAF (!), all of which coming from France, Spain (e.g. Spain, Barcelone, Costas de Garraf, falaises argilo-calcaires, 16.05.1929, *F. Sennen* 7241; Baleares, Palma à Cas Catala, garrigues, 12.06.1933, *F. Sennen* 8617) and Morocco (Kabila de los Santos, escarpe-

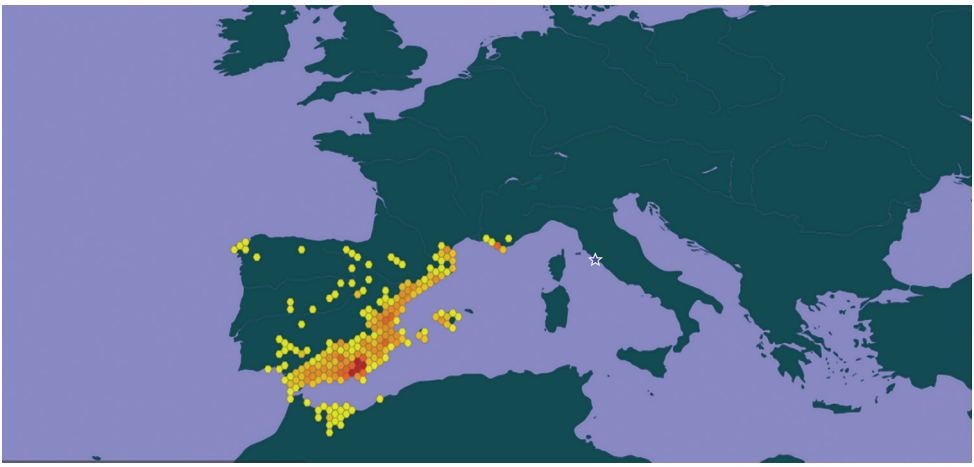

Figure 3. Distribution range of *A. cytisoides* (yellow to red dots show increasing frequency of records) and locality of its finding in Tuscany (asterisk; adapted from GBIF, https://www.gbif.org/species/5352466).

ments calcaires, 07.05.1931, *Sennen et Mauricio s.n.*; Beni-Bu-Yahi, montes Idbiren, 21.06.1932, *Sennen et Mauricio* 8392).

Biogeographically, the presence in Tuscany is noteworthy as it extends considerably to the east the range of this mainly western mediterranean species. In fact, the Tuscan population is quite isolated from the closest ones in southern France, that occur about 500 km to the west (Fig. 3). Concerning its origin, the possibility that its presence could not be natural seems to be excluded. The plant grows in a site with no signs of human disturbance, in the typical habitat where it is found in the main part of its range, e.g. low shrub or garrigue-like communities on rocky limestone soil or calcareous escarpments (Benedì 2000). Because of its severity and the competition by native species (mainly *Erica multiflora* L. and *Salvia rosmarinus* Spenn.), this kind of habitat is hardly colonizable by alien plants. In the third week of may, *A. cytisoides* was in full flower, suggesting its reproductive ability in the local environment. In addition, this species is not reported as a commonly cultivated plant and is not considered of particular ornamental value. As no tendency to become naturalized is documented, it is unlikely that the local population could have originated from plants escaped from gardens in the area.

Assuming that the population is native to Mt. Argentario, the question arises about the causes of such a wide disjunction from the rest of the species range. Two hypotheses can be offered. The population could be a remain of a formerly more continuous range along the coasts of the north Tyrrhenian basin, from south France to Liguria and Tuscany. More probably, it could be more recent and originated fom events of long-distance dispersal mediated by overwintering birds with seasonal migration from north Africa to the north Mediterranean and rest of Europe. Many of these bird species are important agents of plant dispersal and have likely contributed to the homogenization of the floras of North Africa and the Mediterranean countries (Thompson 2005).

Anthyllis cytsoides grows on a high slope facing the sea to the southwest, which may represent a suitable site for a first stop and rest of the migratory birds arriving from Africa and the southern parts of the Mediterranean. The fruiting calyx of this species is hairy-villous and both legume and seeds are small-sized, two traits that likely favor their attachment to the surface of birds and long-distance transport.

The finding of a woody species new to Italy on Mt. Argentario may appear unexpected, as this area is considered phytogeographically well-known (Angiolini et al. 2005). Since the XIX century, numerous botanists have studied its diverse flora and vegetation, some of which in relatively recent times (Baldini 1995; Arrigoni and Di Tommaso 1997). As observed by Rosati et al. (2019), however, this kind of findings in supposedly well-known territories show that field researches can still lead to significant progresses in our knowledge of the national floristic heritage, particularly rich in rare species, thus increasing the base of data for its long-term conservation.

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RESEARCH ARTICLE

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Bryophyte diversity hotspot: the Marmore Waterfalls Regional Park (Umbria, central Italy)

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Abstract

A study of the bryophyte of Marmore Waterfall Natural Park a very peculiar territory for its geological, biogeographical and bioclimatic traits, was carried out. The reported data were collected in the valley area of 'Parco Fluviale del Nera' Regional Park, where the waters are flowing and the humidity of the rocks is oozing. Research led to the identification of 101 taxa of bryophytes (21 liverworts and 80 mosses), among which two liverwort and 10 moss species are new records for the Umbria region, while four are confirmed. The study offers new outcomes on neglected aspects of the flora of central Italy and represents a considerable improvement of the floristic, biogeographical and ecological understanding of its bryophytic component. Additionally, the area turn out to be significant from the conservation point of view both nationally and internationally considering that it harbours high diversity of bryophytes species among which many rare, threatened and interesting species occur. Eighteen species of conservation interest in Italy are recorded during the latest investigation (all in category NT – near threatened). Additionally two species that are considered data deficient in Italy are present in the researched area (*Conocephalum salebrosum* and *Fissidens curvatus*). Also, there is a small populations of a species vulnerable (*Marchantia paleacea*), endangered (*Bryum calophyllum*) and data deficient (*Fissidens curvatus* and *Barbula bolleana*) in European scale.

Keywords

Bryophyte, ecology, Habitats Directive 92/43/EEC, liverworts, mosses, Petrifying springs, Umbria

Introduction

The Regional Park Marmore waterfalls are man-made waterfalls, built by ancient Romans at 271 BC for tried to solve the problem of the Velino River and Valnerina weatlands and, at the same time, to use the water resource both for the agriculture and as a source of power. With a total height of 165 m, it is one of the highest man-made waterfalls in Italy and worldwide.

The Marmore Falls is located in the Umbrian Region (42°33'23"N, 12°42'73"E) near the Terni city at 218 m above sea level, within the Valnerina valley in the 'Parco Fluviale del Nera' Regional Park (Fig. 1). It is a Site of Community Importance (SCI) IT5220017 and a Special Area of Conservation (SAC) of the Natura 2000 EU-wide network due to the presence of the 72.20* 'Petrifying springs with tufa formation (Cratoneurion)' Annexe I priority habitat (http://vnr.unipg.it/habitat/) Biondi et al. (2009). An important stipulation within the habitats directive manual is that 'in order to preserve this habitat of very limited expanse in the field, it is essential to preserve its surroundings and the whole hydrological system concerned'. Petrifying springs fall under the remit of the Water Framework Directive (Directive 2000/60/EC) as groundwater-dependent terrestrial ecosystems (Pedley 1990; Pentecost 1995; Ford and Pedley 1996; Curtis et al. 2009; Kimberley et al. 2013); their ecological significance is recognised under this legislation and there is a legal requirement to maintain or improve the status of the ground waters with which they are fed.

The vegetation type "Cratoneurion commutati" was first described by Walo Koch in his 1928 monograph 'Die höhere Vegetation der subalpinen Seen und Moorgebiete des Val Piora'. This alliance (sometimes shortening the name to Cratoneurion) as freshwater, lime-rich spring communities with frequent tufa formation, is found especially

Figure 1. Schematic Map of the study area.

in the montane and sub-Alpine zone, in which the ground layer consisted of mosses (Lyons and Kelly 2016).

The first bryological explorations made at the Marmore Falls date back to 1869 where author recorded for the first time in the Umbria Region of the tufa moss *Cratoneuron commutatum* (Hedw.) Roth, currently *Palustriella commutata* (Hedw.) Ochyra (Fiorini Mazzanti 1869).

The particular environment, with a gorge and waterfall (Fig 2.), created a very special microclimate that allowed the establishment of interesting liverworts and moss flora which have been studied in recent years (Ellis et al. 2014; Poponessi et al. 2014; Ellis et al. 2016, 2017, 2018). In this study we present the first catalogue of species recorded within the protected area.

Material and method

The site of the park, has been examined from a bryological point of view in the year 2008 during a single inspection and in the years 2012–2018 with repeatedly investigation (especially from October to March, even twice a month). Collectors have inspected

Figure 2. Tufa morphologies Marmore waterfalls: **A** vertical slope seepage with *Palustriella commutata* **B** rock outcrops with tufa **C** banks Nera river **D** tuff steps (closed waterfall view) **E** complex tufa block **F** block of fossil tufa.

the area almost always on the same day or alternatively. The transect methodology was applied with aim to cover as much as possible habitat and microhabitat types, with special emphasis on wet habitats. We also investigated in a less hydrophilic context, poor in cormophytic vegetation and with a more mineral substrate. The *exsiccata* were stored in the Herbarium PERU of the Department of Chemistry, Biology and Biotechnologies, University of Perugia and labels will be available soon on web http://www.anarchive.it (Panfili et al. 2004). Additionally, small collection is deposited in bryophyte collection of Belgrade University Herbarium – BEOU. The nomenclature of taxa follows Söderström et al. (2016) for the liverworts and Ros et al. (2013) for the mosses and the novelties in bryological nomenclature follows Hodgetts et al. (2019a).

Results

The research conducted resulted in identification of 101 bryophytes taxa: 21 liverworts and 80 mosses. According to Aleffi et al. (2008), 2 liverworts and 11 mosses are new records for the Umbria region and additionally 3 liverworts and one moss are newly confirmed. The complete list of the identified bryophytes is reported hereafter. The taxa are listed in alphabetical order. The new taxa for the Umbria region are marked with an asterisk (*), while the symbol "#" indicates a confirmation of the old and doubtful records in the region.

List of taxa

Liverworts

Aneura pinguis (L.) Dumort.: on the bank of the Velino river.
Apopellia endiviifolia (Dicks.) Nebel & D. Quandt: very abundant in the study area. Grows on wet rock.
* *Cephaloziella baumgartneri* Schiffn.: on dry rock at the entrance to damp cavities.
Cololejeunea rossettiana (C.Massal.) Schiffn.: abundant on base rich substrate.
Conocephalum conicum (L.) Dumort.: very abundant near the waterfall and in the study area.
Conocephalum salebrosum Szweyk., Buczk. & Odrzyk.: locally abundant at entrance to "Grotta degli Innamorati".
Jungermannia atrovirens Dumort.: abundant on damp limestone.
Lejeunea cavifolia (Ehrh.) Lindb.: on rocks and trees in shaded and humid places.
Lophocolea bidentata (L.) Dumort.: abundant in damp places.
Lunularia cruciata (L.) Dumort. ex Lindb.: particularly in damp, shady places.
Marchantia paleacea Bertol.: on damp limestone.
Marchantia polymorpha L. subsp. *polymorpha*: very abundant in damp and shady places.
* *Marchantia polymorpha* subsp. *montivagans* Bischl. & Boissel.-Dub.: only presence on lightly shaded and base-rich soil.

Marchantia polymorpha subsp. *ruderalis* Bischl. & Boissel.-Dub.: on disturbed habitats, at the edges of the tourist trails.
Marchantia quadrata Scop.: grows on dry rock.
Mesoptychia turbinata (Raddi) L.Söderstr. & Váňa : on calcareous substrates.
Pellia epiphylla (L.) Corda: on shaded banks.
Porella platyphylla (L.) Pfeiff.: on bark of *Alnus glutinosa* (L.) Gaertn.
Radula complanata (L.) Dumort.: on bark of *Alnus glutinosa* and *Fraxinus excelsior* L.
Reboulia hemisphaerica (L.) : on limestone pavement and on earthy.
Solenostoma gracillimum (Sm.) R.M.Schust.: on soft rock.
Southbya tophacea (Spruce) Spruce: on limestone rock.

Mosses

Barbula unguiculata Hedw.: disturbed and open habitats.
Brachytheciastrum velutinum (Hedw.) Ignatov & Huttunen var. *velutinum*: on stones and compacted soil.
Brachythecium rivulare Schimp.: on runnels and wet ledges.
Brachythecium rutabulum (Hedw.) Schimp. var. *rutabulum*: very abundant on rock and walls.
Bryum calophyllum R.Br.: on soil along waterways.
**Bryum gemmiparum* De Not.: on dry walls.
Calliergonella cuspidata (Hedw.) Loeske: on dry walls, rock and soil.
Cratoneuron filicinum (Hedw.) Spruce: near the cascade.
Ctenidium molluscum (Hedw.) Mitt.: on dry rock.
Didymodon fallax (Hedw.) R.H.Zander: on wet soil and rock.
Didymodon ferrugineus (Schimp. ex Besch.) M.O.Hill: on dry soil.
Didymodon insulanus (De Not.) M.O.Hill: on walls.
**Didymodon spadiceus* (Mitt.) Limpr.: on soil and limestone rock.
Didymodon tophaceus (Brid.) Lisa: on limestone rock.
Encalypta streptocarpa Hedw.: on limestone rock.
Eucladium verticillatum (With.) Bruch & Schimp.: on wet limestone rock.
Exsertotheca crispa (Hedw.) S.Olsson, Enroth & D.Quandt: on limestone rock and walls in lightly shaded sites.
Fissidens bryoides Hedw. var. *bryoides*: on streamsides.
Fissidens crassipes subsp. *warnstorfii* (M.Fleisch.) Brugg.-Nann.:
Fissidens crassipes Wilson ex Bruch & Schimp. subsp. *crassipes*: on wet rock.
Fissidens crispus Mont.: on soil.
Fissidens curvatus Hornsch.: on soil.
Fissidens exilis Hedw.: on soil.
Fissidens osmundoides Hedw.: on limestone rock and walls in lightly shaded sites.
Fissidens rufulus Bruch & Schimp.: immersed in the water.
Fissidens serrulatus Brid.: on limestone rock and walls in lightly shaded sites.
Fissidens taxifolius Hedw. subsp. *taxifolius*: is common on soil or in cracks and crevices in rock.

#*Gymnostomum calcareum* Nees & Hornsch.: on limestone rock.
Homalothecium sericeum (Hedw.) Schimp.: on dry places.
Hydrogonium bolleanum (Müll. Hal.) A. Jaeger: on dripping stone wall.
Hygroamblystegium fluviatile (Hedw.) Loeske: on fast-flowing streams.
Hygroamblystegium tenax (Hedw.) Jenn.: on wet substrate.
Hygroamblystegium varium (Hedw.) Mönk. *subsp. varium*: on wet substrate.
**Hymenostylium recurvirostrum* (Hedw.) Dixon var. *recurvirostrum*: on soil with high-humidity.
Hypnum cupressiforme Hedw. var. *cupressiforme*: on the bark of *Ostrya carpinifolia* Scop.
Hypnum cupressiforme Hedw. var. *filiforme* Brid.: on the bark of *Ostrya carpinifolia*.
Imbribryum mildeanum (Jur.) J.R.Spence: on wet rock.
Isothecium alopecuroides (Lam. ex Dubois) Isov.: on limestone rock.
Kindbergia praelonga (Hedw.) Ochyra: on wet rock.
Leptodon smithii (Hedw.) F.Weber & D.Mohr: on the bark of *Ostrya carpinifolia*.
Leucodon sciuroides (Hedw.) Schwägr.: on the bark of *Ostrya carpinifolia*.
* *Mnium hornum* Hedw.: on wet rock and soil.
Mnium stellare Hedw.: on wet soil.
Orthotrichum diaphanum Schrad. ex Brid.: on the bark of *Ostrya carpinifolia*.
Oxyrrhynchium hians (Hedw.) Loeske: on the wet soil and rock.
Oxyrrhynchium speciosum (Brid.) Warnst.: on the wet soil and rock.
Palustriella commutata (Hedw.) Ochyra: present along the vertical walls to waterfall.
**Palustriella falcata* (Brid.) Hedenäs: present along the vertical walls to waterfall.
Plagiomnium affine (Blandow ex Funck) T.J.Kop.: on the wet soil.
Plagiomnium cuspidatum (Hedw.) T.J.Kop.: on the wet soil.
**Plagiomnium elatum* (Bruch & Schimp.) T.J.Kop.: on the wet soil.
Plagiomnium ellipticum (Brid.) T.J.Kop.: on the wet soil.
Plagiomnium undulatum (Hedw.) T.J.Kop.: on the wet soil.
Plasteurhynchium meridionale (Schimp.) M.Fleisch.: on soil.
Pleurozium schrebei (Willd. ex Brid.) Mitt.: on limestone soil.
**Pohlia annotina* (Hedw.) Lindb.: on wet soil.
**Polia melanodon* (Brid.) A.J.Shaw: on wet soil.
Pohlia wahlenbergii (F.Weber & D.Mohr) A.L.Andrews var. *wahlenbergii*: on limestone soil near the cascade.
Pseudoscleropodium purum (Hedw.) M.Fleisch.: among rocks and on rock ledges.
Ptychostomum archangelicum (Bruch & Schimp.) J.R.Spence: among rocks and on rock ledges.
Ptychostomum capillare (Hedw.) Holyoak & N.Pedersen: among rocks and on rock ledges.
Ptychostomum donianum (Grev.) Holyoak & N.Pedersen: on soil.
Ptychostomum imbricatulum (Müll.Hal.) Holyoak & N.Pedersen: on soil.
Ptychostomum torquescens (Bruch & Schimp.) Ros & Mazimpaka: on limenstone soil and rock.
Rhizomnium punctatum (Hedw.) T.J.Kop.: on soil.: on damp or wet soil.
Rhynchostegiella tenella (Dicks.) Limpr. var. *tenella*: on limestone rock.
Rhynchostegium confertum (Dicks.) Schimp.: on rock and walls.

Rhynchostegium megapolitanum (Blandow ex F.Weber & D.Mohr) Schimp.: accumulated soil on walls.
Rhynchostegium riparioides (Hedw.) Cardot: on along the banks of rivers.
Scorpiurium circinatum (Bruch) M.Fleisch. & Loeske: on rocks and the base of trees.
Syntrichia leavipila Brid.: on walls and rocks.
Tortella inflexa (Bruch) Broth.: on limestone rock.
Tortella tortuosa (Hedw.) Limpr. var. *tortuosa*: on moist, often shaded or sheltered rocks and walls.
**Tortula marginata* (Bruch & Schimp.) Spruce: on moist, often shaded or sheltered rocks and walls.
Trichostomum crispulum Bruch: on shaded calcareous.
**Weissia brachycarpa* (Nees & Hornsch.) Jur.: On wet soil.
Weissia controversa Hedw. var. *controversa*: on damp, bare soil.
**Weissia rutilans* (Hedw.) Lindb.: on damp, bare soil.
Zygodon rupestris Schimp. ex Lorentz: on the bark of old trees.

Discussion

The results of this survey bring undoubtly the idea of significance of this area as one of the region of high bryophytes diversity. Though, the hydrogeology of the investigated area is so peculiar *per se*, it offers so many microhabitat types that also this aspect should be taken into consideration when estimated this zone natural peculiarities.

The bryophytic flora and its role in the deposition of active travertines has been well documented over time (Charrier 1952; Pavletić 1955; Weijermars et al. 1986; Pentecost 1987; Zhang 1996). The sponge-like nature of travertine is no doubt important in the retention of water, often resulting in luxuriant bryophytes growth and the maintenance of the high water humidity in nearby sites. Therefore petrifying springs are lime-rich water sources which deposit tuff (or tufa). The water is rich in carbon dioxide and dissolved calcium carbonate. By contacting the atmosphere, carbon dioxide is outgassed and calcium carbonate is deposited as tufa. The resulting ecological conditions, with high pH and constant inundation by water and deposition of precipitated calcium carbonate, constitute a challenging environment for bryophytes to colonise.

The reported bryophytic survey shows a high level of floristic and biogeographical diversity for a Priority Habitat 7220 and gorge of the Marmore waterfall. It significantly improves the knowledge of a territory, which was already known for providing peculiar habitats for rare and endangered bryophytes taxa (Ellis et al. 2014; Poponessi et al. 2014; Ellis et al. 2016, 2017, 2018).

Additionaly, ecologically contrasting species like mesophilic *Rhynchostegiella tenella*, and more xerophilic (*Ctenidium molluscum*, *Leucodon sciuroides*) are often recorded in short distance one from another suggesting transitional gradient of habitat condition in very small scale. Some species are rather plastic from the point of view of their water requirements and habitat water regime (*Barbula unguiculata*,

Brachythecium rutabulum), and can be recorded in range of microhabitat type suggesting wider ecological valences, and genetic plasticity.

In the sence of biomass and abudance *Palustriella commutata* (syn. *Cratoneuron commutatum* (Hedw.) G. Roth), is the species characteristic to Priority Habitat 7220, and it is well presented along the vertical walls to Marmore waterfall. It forms almost monospecific pillows which constitute the portion of active deposition to travertines. In other portions of the waterfall, where the formation of travertine remains active, generally we observed the repetitive composition of the following species: *Brachythecium rivulare*, *Barbula bolleana*, *Bryum gemmiparum*, *Conocephalum conicum*, *Cratoneuron filicinum*, *Didymodon tophaceus*, *Eucladium verticillatum*, *Hymenostylium recurvirostrum*, *Jungermannia atrovirens*, *Palustriella commutata*, *Pellia endiviifolia*, *Rhynchostegium riparioides* which is in accordance with the similar sites reported elsewhere (e.g. Hugonnot et al. 2017). High flows impose considerable stresses on bryophytes, and the pleurocarp, with long, and somewhat flexible stems, partly buried in the travertine have a clear advantage in survival of such environmental conditions.

The taxa that repeatedly and most frequently occurred in the limestone portion with dripping and/or oozing rock were: *Eucladium verticillatum*, *Conocephalum conicum*, *Pellia endiviifolia*, *Barbula bolleana*, *Gymnostomum calcareum* and *Didymodon tophaceus*

Eucladium verticillatum, tended to grow on steeper, more sheltered terrain. This acrocarp moss was absent from sites with high water flow and it gained moisture mainly from spray or capillarity. Unlike *P. commutata* which forms almost monospecific pillows and is definitely the moss significant in tufa formation as considered its biomass, *E. verticillatum* was often intermixed with other species also not of great biomass. Among others *Didymodon tophaceus* and *Gymnostomum calcareum* were mostly recorded as associate species.

Three species among bryophytes recorded were categorized as Potentially Negative Indicator Species, depend on the circumstances in which they occurred. *Cratoneuron filicinum*, *Brachythecium rivulare* and *Platyhypnidium riparioides* can be indicative of nutrient enrichment, especially elevated phosphate levels. However, these species (especially *C. filicinum*) can occur individually at low levels of abundance in springs with Good water quality, where they form part of a mixed bryophytes assemblages along with other characteristic petrifying spring species (Lyons and Kelly 2016).

Cephaloziella baumgartneri and *Marchantia polymorpha* subsp. *montivagans* are newly recorded liverworts taxa for the Umbria Region. Additionally, *M. polymorpha* subsp. *montivagans* is rare in central and southern Italy. They are localized along the Nera river where the banks flow into the tourist route of the Marmore Didactic Centre. *M. polymorpha* subsp. *ruderalis* is confirmed for the flora of Region and it is localized along antropogenic pathway. The most abundant liverworts in the investigated area were *C. conicum* and *P. endiviifolia*. They occur in moist, shaded positions and seems to be strongly restricted to calcareous substrates. Indeed they grow frequently along streams, bases of moist rocks and cliffs, and especially near the waterfalls.

All liverworts recorded at the Marmore waterfall are very interesting from biodiversity point of view of this park. The region is also very significant in harbouring such a lot liverwort species that are Near Threatened (NT) nationally. According to IUCN criteria they are likely to qualify for a threatened category in the near future. *Conocephalum salebrosum*

is evalutated Data Deficient (DD) in Italy, since it was recently reported for Umrbia and Italy in the Marmore waterfall area (Poponessi et al. 2014).

Marchantia paleacea is a rare liverwort in central and southern Italy (Aleffi et al. 2008). This taxon has been assigned to the tropical montane-submeridional geographical element (Dierßen 2001). Sabovljevic et al. (2019) and Hodgetts et al. (2019a) considered this taxon Vulnerable in Europeean level. Thus, the population in Marmore waterfall area gives the region internationally significance from the conservation aspect and even higher national responsibility in protecting it. *Bryum gemmiparum* have a localized distribution on open limestone pavement where it grows in small damp crevices amongst other mosses like *Rizomnium punctatum*. It is firstly reported for the Umbria Region and it is very rare in Italy (Aleffi et al. 2008). In Europe, it is considered stable (Hodgetts et al. 2019c), but it is nationally threatened in Great Britain, Ireland, Malta, Germany, Switzerland, Bulgaria and Romania (Hodgetts 2015). In Portugal and Greece, it seems to be quite abundant and overall population in Europe is stable but it is under constant threat due to habitat damage and destruction (Hodgetts et al. 2019c).

Weissia rutilans is a rare moss in Italy (Aleffi et al. 2008). Hodgetts (2015) considered it as a candidate for the European Bryophyte Red list due to its presence in many national red lists. However, the number of known population is rather high and the overall European population seems to be stable thus it is not assessed as threatened in Europe (Hällingback et al. 2019d). Nationally, it is CR in Romania and Switzerland, EN in Austria and Czechia, VU in Sweden, Ireland and Spain, and threatened also in Germany and Poland (Hodgetts 2015). Elsewhere it is data deficient or simply not threat-assessed.

Other taxa recorded for the first time in the Umbria Region are: *Didymodon spadiceus*, *Hymenostylium recurvirostrum* var. *recurvirostrum*, *Mnium hornum*, *Palustriella falcata*, *Plagiomnium elatum*, *Pohliaannotina*, *P. melanodon*, *Tortula marginata* and *Weissia brachycarpa*. These are all significant bryophytes representatives of high-humidity stands, habitat types that in time of severe climate changes undergo strong decrease especially in southern Europe.

Barbula bolleana is very rare in Italy but very abundant in this habitat in the investigated area, which consists of a dripping stone wall, with chalky incrustations at its base, suggesting it takes an active part in the formation of tufa. *B. bolleana* is a hygrophilous and calcareous moss for the first time reported on the Marmore Falls site according to Ellis et al. (2016). It is CR in Portugal and possibly extinct in Switzerland, rare and data deficient elsewhere in Europe (Schröck et al. 2019). According to Hodgetts et al. (2019a) this species is rather under recorded in Europe. It is considered as DD over European continent and overall European population trend is unknown (Schröck et al. 2019). The makes the report and presence of this species even more valuable within this regional natural park.

An interesting acrocarp moss found in Marmore Waterfall is *Fissidens rufulus* and it has been firstly reported for Umbria Region recently (Ellis et al. 2016). It was abundant in the area where it was discovered, colonizing intermittently submerged limestone rocks. In the Marmore Waterfall site, a very special microclimate allowed the establishment of *F. rufulus* assemblages. According to Hodgetts (2015), it was a candidate species for European bryophyte red list. *F. rufulus* is an uncommon plant,

listed as Nationally Scarce in Britain (Lockhart et al. 2012), RE in Sweden and the Netherlands, CR in Romania, EN in Switzerland, Luxembourg, Ireland and Northern Ireland, VU in Austria and Slovakia, Near Threatened in the Czech Republic, Data Deficient in Poland, and Spain, rare in Ukraine and seldom recorded elsewhere in Europe: France, Croatia, Greece and Russia (Hodgetts 2015). Hodgetts et al. (2019a, b) assessed it at European level as least concern but since the overall European population decreasing they suggest species monitoring.

Ecologically significant species of petrifying springs which serve as positive indicators of habitat status consist largely of mosses and liverworts, with a smaller number of vascular plants. Rather high diversity of bryophytes is not proportional to small surface of studied areas. This is a consequence of the high portion of microhabitat types and quick gradient changes from ecological humid situations to shaded humid and irradiated dry sites. Also, from the bryological point of view protected area of Parco Fluviale del Nera' Regional Park is a habitat of many regionally, nationally threatened and scarce species and harbour a good population of species of European conservation interest. Further studies and monitoring programs are welcomed in future with aim to maintain survival of national and European significant bryophytes species. During these years of study, Carmela Cortini Pedrotti Bryological Path was established. Entitled to Professor Cortini, who spent her life studying bryophytes (1931–2007). She is forever remembered for her work with, and great knowledge of Bryophyte. The path runs along the tourist trail number 2 of the waterfall site and has been enriched with information boards concerning the bryophytes that have been found in the site and along the path.

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RESEARCH ARTICLE

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Notulae to the Italian native vascular flora: 10

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Abstract

In this contribution, new data concerning the distribution of native vascular flora in Italy are presented. It includes new records, confirmations, exclusions, and status changes to the Italian administrative regions for taxa in the genera *Artemisia*, *Chaetonychia*, *Cirsium*, *Cynanchum*, *Genista*, *Hieracium*, *Iberis*, *Melica*, *Misopates*, *Myosotis*, *Thalictrum*, *Trifolium*, *Utricularia*, *Veronica*, and *Vicia*. Nomenclatural and distribution updates, published elsewhere, and corrigenda are provided as supplementary material.

Keywords

Endemic, Floristic data, Italy

How to contribute

The text for the new records should be submitted electronically to Chiara Nepi (chiara.nepi@unifi.it). The corresponding specimen along with its scan or photograph have to be sent to FI Herbarium: Sezione di Botanica "Filippo Parlatore" del Museo di Storia Naturale, Via G. La Pira 4, 50121 Firenze (Italy). Those texts concerning nomenclatural novelties (typifications only for accepted names), status changes, exclusions, and confirmations should be submitted electronically to: Fabrizio Bartolucci (fabrizio.bartolucci@gmail.com). Each text should be within 1,000 characters (spaces included).

Floristic records

***Artemisia caerulescens* L. subsp. *cretacea* (Fiori) Brilli-Catt. & Gubellini (Asteraceae)**

+ **CAL**: Caccuri (Crotone) lungo il Torrente Lepre presso loc. Bagni di Repote (WGS84: 39.218358N; 16.836357E), calanco, 145 m, 11 October 2018, *A. Stinca* (FI, PORUN-Stinca). – Species and subspecies new for the flora of Calabria.

A. Stinca, G. Chianese, A. Esposito

***Chaetonychia cymosa* (L.) Sweet (Caryophyllaceae)**

+ **SAR**: Siniscola (Nuoro), Loc. Petriolu (WGS84: 40.488720N; 9.810100E), margine di una vecchia carraia, esp. S, 12 m s.l.m., 17 May 2020, *G.B. Pau* (SS). – Species confirmed for the flora of Sardegna.

Chaetonychia cymosa is a western-Mediterranean species (Pignatti et al. 2017), native to the Iberian Peninsula (Balearic Islands excluded), south of France, Corsica, Sardegna, Morocco, and Tunisia (Soriano Martin 1997). It was recorded for the first time in Sardegna in 1840 by Domenico Lisa (Mattirolo 1893), and later confirmed by Fiori (1923) and by Pignatti et al. (2017). However, according to Arrigoni (2010) and Bartolucci et al. (2018), this species was known only due to historical records.

G.B. Pau, S. Bagella

***Cirsium vulgare* (Savi) Ten. subsp. *vulgare* (Asteraceae)**

+ **CAM**: Castellammare di Stabia (Napoli), località Quisisana (WGS84: 40.686260N; 14.481711E), bordo strada, 172 m, 22 June 2020, *A. Stinca* (FI, PORUN-Stinca). – Subspecies new for the flora of Campania.

A. Stinca, G. Mei, A. Esposito

***Cynanchum acutum* L. subsp. *acutum* (Apocynaceae)**

+ **ABR**: Città Sant'Angelo (Pescara), Marina di Città Sant'Angelo, riva sinistra del Fiume Saline presso la foce, sull'argine (WGS84: 42.525742N; 14.150094E), spiaggia, 1 m, no exp., 8 May 2018, leg. *G. Galasso*, det. *G. Galasso, E. Banfi* (MSNM); *ibidem*, 16 May 2020, *F. Conti, V. Giacanelli* (APP, MSNM); *ibidem*, 29 May 2020, *F. Conti, V. Giacanelli* (FI, APP). – Subspecies new for the flora of Abruzzo.

F. Conti, V. Giacanelli, G. Galasso

***Genista etnensis* (Raf.) DC. (Fabaceae)**

+ (NAT) **TOS**: Civitella Marittima (Grosseto) (WGS84: 42.994981 N; 11.289629 E), scarpata stradale presso lo svincolo sulla strada Siena-Grosseto, 278 m, 6 Jun 2020, *F. Selvi 3980* (FI). – Naturalized regional alien species new for the flora of Toscana.

In the locality reported here, a few plants of this species, otherwise endemic to Sicilia and Sardegna, were introduced about 20 years ago for the stabilization of a road embankment. At present, it occurs with a few old plants and *ca*. 15 younger individuals in the close surroundings, established by natural regeneration. In early June 2020, these plants bore flowers and young fruits, showing their reproductive capacity under local conditions.

F. Selvi

***Hieracium ramosissimum* Schleich. ex Hegetschw. subsp. *conringiifolium* (Arv.-Touv.) Zahn (Asteraceae)**

+ **EMR**: Agnelli, Coli (Piacenza), margine strada (WGS84: 44.72341N; 9.43767E), 980 m s.l.m., exp. Nord, 10 July 2019, *S. Orsenigo*, det. *G. Gottschlich* (PAV, *Herb. Orsenigo*). – Subspecies confirmed for the flora of Emilia-Romagna.

Hieracium ramosissimum subsp. *conringiifolium* was reported in Emilia-Romagna as doubtfully occurring (Bartolucci et al. 2018). Some historical records (sub *H. conringiifolium* Arv.) were reported for the province of Piacenza by Bracchi and Romani (2010), who referred to Pavarino (1915) and Pavesi (1906). In particular, the latter author collected this subspecies in the area of Sassi Neri, between Lombardia and the Emilia-Romagna border, in an area probably falling within the municipality of Bobbio (Piacenza).

S. Orsenigo, G. Gottschlich

***Iberis semperflorens* L. (Brassicaceae)**

+ (CAS) **TAA**: Torbole (Trento) (WGS 45.870667N; 10.87834667E), pendio esposto a sud, 111 m, 25 January 2020, *M. Merli* (FI, ROV, *Herb. Merli*). – Casual regional alien species new for the flora of Trentino-Alto Adige.

M. Merli, G. Galasso

***Melica transsilvanica* Schur subsp. *klokovii* Tzvelev. (Poaceae)**

+ **LIG**: Magliolo (Savona), impluvio del Torrente Maremola (WGS84: 44.19523907N; 8.2349215E), affioramento di dolomia, 270 m, 7 December 2019, *A. Alberto, A. Baroni, F. Baroni, I. Briozzo, S. Briozzo, C. Cibei, D. Dagnino, D. Dozza, D. Longo, M. Ottonello, R. Paneri, S. Peccenini, E. Rodi* (GE No. 1613, FI). – Subspecies new for the flora of Liguria.

No information was available on the occurrence of *Melica transsilvanica* subspecies in Liguria (Bartolucci et al. 2018).

D. Dagnino, C. Cibei

***Misopates calycinum* Rothm. (Plantaginaceae)**

+ **LIG**: Sori (Genova), sotto la Torre Saracena di Polanesi (WGS84: 44.367555N; 9.122138E), fasce abbandonate, 170 m, 17 June 2020, *M. Calbi* (GE No. 2566). – Species confirmed for the flora of Liguria.

The most recent report dates back to Gismondi (1949) for a locality (Mulinetti di Recco, along the railway) not far from the place of the new discovery.

G. Barberis, M. Calbi

***Myosotis sylvatica* Hoffm. subsp. *subarvensis* Grau (Boraginaceae)**

+ **CAM**: Montevergine (Avellino) (WGS84: 40.937195N; 14.724666E), radura all'interno di una faggeta, 1315 m, 07 July 2016, *F. Scafidi* (FI). – Subspecies new for the flora of Campania.

This taxon has been identified according to Grau (1964).

F. Scafidi

***Thalictrum minus* L. (Ranunculaceae)**

+ **PUG**: Gravina in Puglia (Bari), Pulicchio di Gravina (WGS84: 40.904633N; 16.422215E), 477 m s.l.m., radura di rimboschimento sul fondo del Pulicchio di Gravina, 13 June 2020, leg. *G. Pazienza*, det. *G. Pazienza, L. Forte, V. Cavallaro* (FI; BI No. 42341) – Species confirmed for the flora of Puglia.

In Licht (2018) and Licht and Wagensommer (2020), *Thalictrum minus* was reported as probably occurring in Puglia, in the Gargano Promontory, based on Hand (2001). According to Bartolucci et al. (2018), *T. minus* L. subsp. *minus* was reported in Puglia as no longer recorded. Palanza (1900) reported it under the name "*T. elatum* (Jacq.) Bert." *"Nei pascoli del Pulicchio alle Murgie di Gravina; alla riva dell'Ofanto nel Barlettano"*. The new specimens and a revision of the specimens collected by Palanza (BI Nos. 44166, 44167 and 44240) led us to attribute all of them to *T. minus* L., but left unsolved the attribution to a subspecies.

G. Pazienza, L. Forte, V. Cavallaro

***Trifolium bocconei* Savi (Fabaceae)**

+ **LIG**: Ameglia (La Spezia), "IT 1345109 Montemarcello", nei pressi del sentiero per Punta Bianca (WGS84: 44.038015N; 9.973765E), prateria xerofila mediterranea (Habitat Natura 2000 cod.6220), 85 m, 9 August 2019, *D. Dagnino, C. Turcato*, (GE No. 1359); Calice al Cornoviglio (La Spezia) Loc. Martinello, lungo il torrente Usurana, 3 June 2005, *E. Lattanzi*, (*Herb. Lattanzi*). – Species confirmed for the flora of Liguria.

Several Ligurian localities were reported by De Notaris (1844), Bertoloni (1850–1853), and in Ottone Penzig's handwritten notes found on a copy of De Notaris (1844), stored in the library of the University of Genova. Although this species occurs in most of the Mediterranean Italian regions, it was no longer recorded for Liguria (Bartolucci et al. 2018).

E. Lattanzi, D. Dagnino, C. Turcato

***Utricularia vulgaris* L. (Lentibulariaceae)**

+ **SAR**: Sorso (Sassari), Platamona lagoon (WGS84: 40.815739N; 8.490230E), vegetazione peristagnale a dominanza di *Cladium mariscus*, 2 m s.l.m, 24 June 2020, *G. Rivieccio, M.C. Caria, S. Pisanu, S. Bagella* (SS). – Species confirmed for the flora of Sardegna.

Although this species was reported for Sardegna by Giau (1986), its presence in the island was questioned and only the presence of *Utricularia australis* R.Br. was confirmed (Desfayes 2008; Arrigoni 2013; Bartolucci et al. 2018; Bagella et al. 2020; Orrù et al. 2020). We localized a population of *U. vulgaris* alongside the Platamona lagoon, in Habitat 7210* "Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae" (Gigante et al. 2019).

G. Rivieccio, M.C. Caria, S. Pisanu, S. Bagella

***Veronica vindobonensis* (M.A.Fisch.) M.A.Fisch. (Plantaginaceae)**

– **ITALIA** (TOS). – Species to be excluded from the flora of Italy.

Veronica vindobonensis is an East European species, reported as native in Italy by Walters and Webb (1972) and by Marhold (2011+), but not included in the recent checklists of the Italian vascular flora (Bartolucci et al. 2018, Galasso et al. 2018), nor was it reported by Pignatti et al. (2018). Recently, Arrigoni (2020) listed this species as non-native and doubtfully occurring in Toscana, based on a record published by Del Prete and Tomaselli (1982) for the Apuan Alps that, to the best of my knowledge, is the only verifiable record for Italy. In PI we traced the specimen cited by these authors, but it is actually attributable to *V. chamaedrys* L. subsp. *chamaedrys* (http://erbario.unipi.it/it/erbario/view?id=1623472). Accordingly, I exclude *V. vindobonensis* for the flora of Italy.

F. Roma-Marzio

***Vicia johannis* Tamamsch. (Fabaceae)**

+ **LIG**: Chiusanico (Imperia), sopra Borgata Castello (WGS84: 43.97305N; 7.99425E), oliveto, 477 m, 6 April 2019, *G. Barberis, A. Baroni, F. Baroni, I. Briozzo, C. Cibei, D. Dagnino, A. Giovannini, M. Leone, D. Longo, S. Peccenini, E. Rodi, V. Terzo* (GE No. 1512, FI). – Species new for the flora of Liguria.

This species is poorly known in Italy, and it has only recently been reported in Veneto, Emilia-Romagna, Lazio, Abruzzo, Molise, and – not confirmed – in Sardegna (Bartolucci et al. 2018, 2019).

I. Briozzo, D. Longo, S. Peccenini

Nomenclatural and distribution updates from other literature sources, and corrigenda

Nomenclatural and distribution updates, and corrigenda to Bartolucci et al. (2018) are provided in Suppl. material 1.

F. Bartolucci, G. Galasso

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Supplementary material 1

Supplementary data

Authors: Fabrizio Bartolucci, Gabriele Galasso

Data type: species data

Explanation note: 1. Nomenclatural updates; 2. Note updates; 3. Distribution updates; 4. Synonyms, misapplied or included names.

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RESEARCH ARTICLE

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Notulae to the Italian alien vascular flora: 10

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Abstract

In this contribution, new data concerning the distribution of vascular flora alien to Italy are presented. It includes new records, confirmations, exclusions, and status changes for Italy or for Italian administrative regions. Nomenclatural and distribution updates published elsewhere are provided as Suppl. material 1.

Keywords

Alien species, floristic data, Italy, nomenclature

How to contribute

The text for the new records should be submitted electronically to Chiara Nepi (chiara.nepi@unifi.it). The corresponding specimen along with its scan or photograph has to be sent to FI Herbarium: Museo di Storia Naturale (Botanica), Sistema Museale di Ateneo, Via G. La Pira 4, 50121 Firenze (Italy). Those texts concerning nomenclatural novelties (typifications only for accepted names), status changes, exclusions, and confirmations should be submitted electronically to Gabriele Galasso (gabriele.galasso@comune.milano.it). Each text should be within 1,000 characters (spaces included).

Floristic records

Achillea filipendulina Lam. (Asteraceae)

+ (CAS) **MAR**: Urbino (Pesaro e Urbino), Monti delle Cesane, basso versante W del Monte della Cesana, tra Case Peschiera e Ca' Mignone (WGS84: 43.730999°N, 12.650354°E), luoghi maceriosi ai margini di una gariga arbustata, ca. 460 m, 1 July 2020, *N. Hofmann* (FI, PESA). – Casual alien species new for the flora of Marche.

Achillea filipendulina is a neophyte native to central and south-western Asia (Ghafoor 2002) and cultivated as ornamental. Recently, a single individual has been detected, growing in a ruderal habitat at the edge of a garrigue, along with *Cotinus coggygria* Scop. and *Spartium junceum* L.

L. Gubellini, N. Hofmann

Bidens lanceolata (L.) Banfi, Galasso & Bartolucci (Asteraceae)

+ (CAS) **TAA**: Trento (Trento), Tangenziale Ovest, uscita Piedicastello, in una rotonda al termine del Lungadige San Nicolò (WGS84: 46.065557°N, 11.111498°E), rotonda stradale, 195 m, 31 May 2020, *G. Bonari* (FI). – Casual alien species new for the flora of Trentino-Alto Adige.

The species, occurring with less than 10 individuals, was found in a flowerbed-like roundabout. Therefore, the place might have been subjected to wildflower seed mixture sown in the past. However, the site looks abandoned. On the other hand, this species might have also arrived from the nearby motorway. Unfortunately, these two explanations are speculative as we don't have data in this respect. In any case, we believe the record is noteworthy, because it suggests the persistence ability of the species.

G. Bonari, C. Wellstein, S. Zerbe

Bidens subalternans DC. (Asteraceae)

+ (NAT) **LAZ**: Alatri (Frosinone), fondovalle in loc. Cosciano (WGS84: 46.719662°N, 13.346098°E), luoghi erbosi a bordo strada, 337 m, 15 October 2018, *E. Fanfarillo* (RO); Orte (Viterbo), nei pressi del casello autostradale (WGS84: 42.453581°N, 12.409637E), stazioni ruderali a bordo strada, 55 m, 27 October 2018, *E. Fanfarillo* (RO); Genzano di Roma (Roma), loc. Ponte Tre Armi (WGS84: 41.677850°N, 12.727938°E), incolti e margini stradali, 265 m, 26 August 2020, *M. Latini* (RO); *ibidem*, tra Ponte San Gennaro e Ponte Tre Armi (WGS84: 41.678913°N, 12.727939°E), incolti e orti, 275 m, 26 August 2020, *M. Latini* (RO). – Status change from casual to naturalized alien for the flora of Lazio.

In Lazio, *Bidens subalternans* was first reported as a casual alien in 2016 in Genzano di Roma (Galasso et al. 2016), where it still occurs and has spread to neighbor-

ing areas. This annual species was also observed by G. Abbate in other localities of Colli Albani at Velletri (Roma), Via Fontana Marcaccio (WGS84: 41.712511°N, 12.782465°E) and Via Passo dei Coresi (WGS84: 41.619027°N, 12.755517°E). This species regularly produces abundant flowers and fruits. Its presence in the same locality for several years, and its occurrence in other provinces, lead us to consider *B. subalternans* as naturalized in Lazio.

M. Latini, G. Nicolella, E. Fanfarillo

***Campsis radicans* (L.) Bureau (Bignoniaceae)**

+ (CAS) **CAL**: Reggio Calabria (Reggio Calabria), fraz. Ortì (WGS84: 38.147734°N, 15.710454°E), scarpata, 607 m, 29 June 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (REGGIO); *ibidem*, fraz. Archi rione Carmine (WGS84: 38.159076°N, 15.666590°E), bordo strada, 56 m, 1 July 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (REGGIO); *ibidem*, loc. Pentimele (WGS84: 38.152204°N, 15.657830°E), bordo strada arrampicata su una rete metallica, 9 m, 17 July 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (REGGIO); Montebello Jonico (Reggio Calabria), contrada Masella (WGS84: 38.004679°N, 15.643481°E), arrampicata su un muro, 56 m, 3 July 2020, leg. *C.M. Musarella*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (REGGIO); *ibidem*, fraz. Saline, borgata Sant'Elia, SS106 (WGS84: 37.932926°N, 15.736238°E), bordo strada, 31 m, 4 July 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (REGGIO); Condofuri (Reggio Calabria), fraz. San Carlo, SS106 (WGS84: 37.928938°N, 15.884340°E), bordo strada, 9 m, 5 July 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (REGGIO); Palizzi (Reggio Calabria), fraz. Spropoli, SS106 (WGS84: 37.924085°N, 16.024619°E), bordo strada, 10 m, 5 July 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO). – Casual alien species new for the flora of Calabria.

Campsis radicans is an ornamental used to cover nets and pergolas. We have observed numerous individuals originating both from seed reproduction and vegetative propagation.

V.L.A. Laface, C.M. Musarella, G. Spampinato

***Cascabela thevetia* (L.) Lippold (Apocynaceae)**

+ (NAT) **ITALIA** (**SIC**): Campofelice di Roccella (Palermo) (WGS84: 37.996910°N, 13.886166°E), in un canale di scolo dell'acqua piovana, 9 July 2019, *G. Domina* (FI); Monreale (Palermo), Via Olio di Lino (WGS84: 38.076133°N, 13.310443°E), bordo strada, 15 July 2020, *E. Di Gristina* (SAF). – Status change from casual to naturalized alien for the flora of Italy; naturalized alien species new for the flora of Sicilia.

Cascabela thevetia is native to Central and South America (Alvarado-Cárdenas et al. 2017), it is cultivated frequently as an ornamental in Sicilia, and was recorded as a casual alien in Calabria (Laface et al. 2020). Several individuals of this species at different growth stages were found in a rainwater drain and on a road edge. These plants

were identified according to Alvarado-Cárdenas et al. (2017), and originated from dispersed seeds from ornamentals growing in nearby private gardens.

E. Di Gristina, F. Scafidi, G. Barone

***Cedrus deodara* (Roxb.) G.Don (Pinaceae)**

+ (CAS) **LIG**: Magliolo (Savona), impluvio del Torrente Maremola (WGS84: 44.18919°N, 8.24017°E), macchia mediterranea, 260 m, 7 December 2019, *A. Alberto, A. Baroni, F. Baroni, I. Briozzo, S. Briozzo, C. Cibei, D. Dagnino, D. Dozza, D. Longo, M. Ottonello, R. Paneri, S. Peccenini, E. Rodi* (FI, GE No. 1613). – Casual alien species new for the flora of Liguria.

D. Longo, C. Cibei

***Cenchrus americanus* (L.) Morrone subsp. *americanus* (Poaceae)**

– **ITALIA** (**VEN**). – Alien species to be excluded from the flora of Italy (Veneto).

The record published by Englmaier and Wilhalm (2018) for Veneto as casual alien and cited by Galasso et al. (2020) is based on a cultivated plant: WSW di Castagnaro (Verona), ca. 500 m a ESE del Ponte di Pietra, campo a riposo, pianta coltivata, 11 m, 28 March 2002, *F. Prosser* (ROV No. 41991 under the name *Pennisetum glaucum* (L.) R.Br.).

F. Prosser

***Cotoneaster hjelmqvistii* Flinck & B.Hylmö (Rosaceae)**

+ (CAS) **TOS**: Pomarance (Pisa), Riserva Naturale Monterufoli-Caselli, presso Podere Monterufolino (WGS84: 43.244828°N, 10.780255°E), margine boschivo, 500 m, 12 June 2020, leg. *L. Pinzani, F. Olivieri*, det. *F. Roma-Marzio* (FI, *Herb. L. Pinzani*). – Casual alien species new for the flora of Toscana.

L. Pinzani, F. Roma-Marzio

***Cotoneaster salicifolius* Franch. (Rosaceae)**

+ (CAS) **PUG**: Brindisi (Brindisi), aiuole in Via Bastioni di San Giorgio (WGS84: 40.636294°N, 17.938775°E), aiuola semi-ombreggiata, ca. 19 m, 24 August 2019, *N. Olivieri* (FI). – Casual alien species new for the flora of Puglia.

Some young individuals of the species have developed in semi-shady flowerbeds. The plants originated from seeds produced by adult individuals growing nearby.

N. Olivieri

***Crocus tommasinianus* Herb. (Iridaceae)**

+ (NAT) **ITALIA** (**LOM**): Olgiate Molgora (Lecco), loc. Bruggione, boschetto nei pressi di Via Consortile Bruggione (WGS84: 45.735548°N, 9.400043°E), bosco misto mesofilo, 300 m, 14 February 2014, *M. Villa* (*Herb. Parco di Montevecchia e della Valle del Curone*); *ibidem*, 25 February 2019, *M. Villa* (PI025542); *ibidem*, 22 Febru-

ary 2020, *F. Roma-Marzio, L. Peruzzi* (FI); Montevecchia (Lecco), Parco Regionale di Montevecchia e della Valle del Curone, loc. Ceresè, boschetto nei pressi di Via Monza (WGS84: 45.68947°N, 9.37343°E), bosco misto mesofilo, 300 m, 22 February 2020, *F. Roma-Marzio, L. Peruzzi, A. Spalma, P. Bolzani, M. Villa* (PI033382). – Naturalized alien species new for the flora of Italy (Lombardia).

+ (NAT) **FVG**: Mezzana del Turgnano (Udine), Bosco Baredi-Selva Aruonchi, al margine destro del sentiero principale (Stradon di Miez), precisamente all'ingresso del bosco (WGS84: 45.786111°N, 13.115033°E), 7 m, 26 February 2020, *M. Bianco* (FI). – Naturalized alien species new for the flora of Friuli Venezia Giulia.

Crocus tommasinianus is native to the NW Balkan peninsula (Harpke et al. 2015), but it is known as introduced alien for Great Britain and Netherlands (Barker 2020). Other localities where this species was observed are: La Valletta Brianza (Lecco), loc. Lissolo (WGS84: 45.736751°N, 9.348045°E); Latisana (Udine), lungo l'argine del Fiume Tagliamento (WGS84: 45.755100°N, 13.006976°E); Lignano Sabbiadoro (Udine), Lungomare A. Kechler (WGS84: 45.666355°N, 13.110460°E); Talmassons (Udine), fraz. Flambro, lungo un fossato appena fuori il centro abitato in Via Tagliamento (WGS84: 45.931594°N, 13.084167°E).

M. Villa, M. Bianco, P. Bolzani, F. Roma-Marzio, L. Peruzzi

***Echinochloa colona* (L.) Link (Poaceae)**

+ (CAS) **MAR**: Fermo (Fermo), fraz. Lido di Fermo, sulla spiaggia (WGS84: 43.2215278°N, 13.7823888°E), sabbie, 1 m, 1 September 2019, *M. Tiburtini* (FI). – Casual alien species new for the flora of Marche.

Several plants have grown in a human-disturbed area where mechanical beach cleaning frequently occurs.

M. Tiburtini, J. Franzoni, F. Roma-Marzio

***Erythrostemon gilliesii* (Wall. ex Hook.) Klotzsch (Fabaceae)**

+ (CAS) **CAL**: Reggio Calabria (Reggio Calabria), loc. Bocale (WGS84: 37.968386°N, 15.756872°E), collina sabbiosa, 298 m, 26 May 2020, leg. *C.M. Musarella*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO). – Casual alien species new for the flora of Calabria.

Erythrostemon gilliesii is commonly cultivated as ornamental. The observed individual probably escaped from the gardens of nearby houses.

V.L.A. Laface, C.M. Musarella, G. Spampinato

***Heliotropium amplexicaule* Vahl (Heliotropiaceae)**

+ (NAT) **SIC**: Catania (Catania), porto di Catania (WGS84: 37.501733°N, 15.096016°E), bordo strada, ca. 1 m, 13 October 2020, *G. Tavilla, D. Azzaro, V. Ranno* (FI, CAT). – Naturalized alien species confirmed for the flora of Sicilia.

For Sicily, *Heliotropium amplexicaule* is reported by Costa and Pavone (2018) inside the Botanical Garden of Catania, and by Pignatti et al. (2018) without invasiveness status. The presence of this species is confirmed as naturalized along the roadside of the port of Catania.

G. Tavilla, D. Azzaro, V. Ranno

***Hesperocyparis glabra* (Sudw.) Bartel (Cupressaceae)**

+ (NAT) **MAR**: Acqualagna (Pesaro e Urbino), Monti del Furlo, versante W-NW del Monte Pietralata, nella parte sommitale del Monte Bregno (WGS84: 43.662655°N, 12.693646°E), pascoli aridi e sassosi, ca. 705 m, 22 July 2020, *L. Gubellini* (FI, PESA). – Naturalized alien species new for the flora of Marche.

Hesperocyparis glabra is a neophyte native to the SW United States of America (Adams et al. 2009; Farjon 2010), widely used as ornamental and for reforestation. The observed population consists of a few dozen young individuals, whose propagation has probably been favoured by a recent forest fire.

L. Gubellini, N. Hofmann

***Houttuynia cordata* Thunb. (Saururaceae)**

+ (CAS) **ITALIA** (**FVG**): Palazzolo dello Stella (Udine), rive del Fiume Stella (WGS84: 45.809452°N, 13.079030°E), bosco ripariale disturbato, 5 m, 16 June 2020, *F. Liccari* (FI); *ibidem* (45.809453°N, 13.079031°E), bosco ripariale disturbato, 5 m, 16 June 2020, *F. Boscutti* (FI). – Casual alien species new for the flora of Italy (Friuli Venezia Giulia).

Houttuynia cordata is a perennial herb native to temperate and tropical Asia, cultivated worldwide as ornamental. It has become naturalized in wetland habitats in New Zealand and the USA (Louisiana), where it is considered invasive (Wunderlin et al. 2010; USDA, NRCS 2020). In Europe it was first reported in Belgium, where it is considered a casual alien (Saintenoy-Simon 2013; Verloove 2020). We found this species growing in a disturbed riverine wood along the river Stella. We observed a few individuals in July 2019, but the species is rapidly spreading due to vegetative propagation; we also observed several flowering individuals. This trend suggests an ongoing naturalization process, with an invasive potential.

F. Liccari, F. Boscutti

***Ibicella lutea* (Lindl.) Van Eselt. (Martyniaceae)**

+ (CAS) **ITALIA** (**SAR**): Laerru (Sassari) (WGS84: 40.814497°N, 8.851962°E), in un erbaio a dominanza di *Sulla coronaria*, 97 m, 1 July 2020, leg. *G. Rivieccio, S. Bagella, V. Bica, L. Lunesu*, det. *L. Lunesu* (FI, SS). – Casual alien species new for the flora of Italy (Sardegna).

Native to South America, *Ibicella lutea* has been reported in Europe for different areas (Verloove 2006; Yannitsardos and Bazos 2006; Tison et al. 2014). The population of Laerru occupies two small portions of a cultivated field (around 3,000 m^2).

G. Rivieccio, L. Lunesu, S. Bagella

***Impatiens parviflora* DC. (Balsaminaceae)**

+ (CAS) **ABR**: Teramo (Teramo), strada secondaria presso Via A. De Gasperi (WGS84: 42.662158°N, 13.707497°E), margine erboso, ca. 250 m, 10 June 2020, *N. Olivieri* (FI). – Casual alien species new for the flora of Abruzzo.

N. Olivieri

***Lantana camara* L. subsp. *camara* (Verbenaceae)**

+ (CAS) **ITALIA** (**PUG**): Brindisi (Brindisi), aiuole in Via Bastioni di San Giorgio (WGS84: 40.636294°N, 17.938775°E), aiuola semi-ombreggiata, ca. 19 m, 24 August 2019, *N. Olivieri* (FI). – Casual alien subspecies new for the flora of Italy (Puglia).

Some young individuals of this taxon are growning in semi-shaded flowerbeds. The plants, identified according to Sanders (2012), originated from seeds produced by some adult specimens present nearby. This subspecies is widely cultivated in Italy as ornamental in areas with a Mediterranean climate, however, unlike *L. camara* subsp. *aculeata* (L.) R.W.Sanders (Thaman 1974), it rarely gives rise to adventitious populations.

N. Olivieri

***Liriope spicata* (Thunb.) Lour. (Asparagaceae)**

+ (CAS) **CAL**: Scilla (Reggio Calabria) (WGS84: 38.239889°N, 15.719085°E), bordo strada vicino ad un castagneto, 378 m, 14 July 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO). – Casual alien species new for the flora of Calabria.

The only plant found probably escaped from cultivation or was thrown together with the waste material from nearby gardens.

V.L.A. Laface, C.M. Musarella, G. Spampinato

***Lobelia erinus* L. (Campanulaceae)**

+ (CAS) **SIC**: Palermo (Palermo), Via Cluverio, nei pressi di Piazza San Francesco di Paola (WGS84: 38.121652°N, 13.351802°E), negli interstizi dei marciapiedi, 22 m, 11 May 2020, *E. Di Gristina* (FI). – Casual alien species new for the flora of Sicilia.

Some mature individuals have been found in sidewalk crevices, probably coming from nearby adult fruiting plants.

E. Di Gristina, F. Scafidi, G. Barone

***Nandina domestica* Thunb. (Berberidaceae)**

+ (CAS) **LAZ**: Roma (Roma), aiuola in Piazza B. Cairoli (WGS84: 41.893619°N, 12.475277°E), margine di aiuola semi-ombreggiata, ca. 31 m, 20 September 2019, *N. Olivieri* (FI). – Casual alien species new for the flora of Lazio.

A few young individuals of this species originated from seeds produced by some adults grown as ornamentals in a nearby flowerbed. *Nandina domestica* is native to China and Japan, and was introduced in Italy in 1821 (Maniero 2015).

N. Olivieri

***Nassella neesiana* (Trin. & Rupr.) Barkworth (Poaceae)**

+ (NAT) **LAZ**: Roma (Roma), Villa Ada (WGS84: 41.928728°N, 12.505276°E), incolto, 40 m, 29 June 2020, *G. Nicolella* (RO). – Status change from casual to naturalized alien for the flora of Lazio.

This species was first recorded in Lazio in 1970 at Villa Ada (Anzalone and Veri 1975) and then collected there also in the following years (Moraldo 1986; Anzalone et al. 2010). Its presence in the same locality 50 years later leads us to consider *Nassella neesiana* as naturalized in this administrative region.

G. Nicolella, M. Latini

***Nothoscordum gracile* (Aiton) Stearn (Amaryllidaceae)**

+ (CAS) **SIC**: Messina (Messina), Viale Boccetta (WGS84: 38.198263°N, 15.551971°E), marciapiede, 26 m, 17 June 2020, leg. *C.M. Musarella*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO); Catania (Catania), Via A. Longo, vicino Orto Botanico (WGS84: 37.515272°N, 15.082627°E), bordo strada, 33 m, 18 June 2020, leg. *C.M. Musarella*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (REGGIO); *ibidem*, Via S. Paola (WGS84: 37.514850°N, 15.081857°E), marciapiede, 37 m, 19 June 2020, leg. *C.M. Musarella*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO). – Casual alien species new for the flora of Sicilia.

Some plants of the species grow in the crevices of sidewalks, having probably escaped from nearby pots or flowerbeds.

V.L.A. Laface, C.M. Musarella, G. Spampinato

***Oxalis dillenii* Jacq. (Oxalidaceae)**

+ (NAT) **SIC**: Palermo (Palermo), Via G. La Farina, angolo Via N. Garzilli (WGS84: 38.1292592°N, 13.3504172°E), negli interstizi dei marciapiedi, 16 m, 16 May 2019, *G. Barone* (FI). – Naturalized alien species new for the flora of Sicilia.

Recent expansion of the range of the species, not yet reported in the recent flora of Palermo (Domina et al. 2020).

E. Di Gristina, F. Scafidi, G. Barone

+ (NAT) **SAR**: Gairo (Nuoro), presso il Rio Sammuccu (WGS84: 39.904900°N, 9.427900°E), bordo stradale moderatamente fresco-umido, 900 m, 21 June 2020, *G. Mereu* (FI). – Naturalized alien species confirmed for the flora of Sardegna.

This species has been indicated as naturalized alien in Sardegna by Arrigoni (2010), but its presence on the island was considered doubtful by Galasso et al. (2018).

G. Mereu

***Papaver orientale* L. (Papaveraceae)**

+ (CAS) **ITALIA** (**UMB**): Norcia (Perugia), Parco Nazionale dei Monti Sibillini, Fonte delle Fate (WGS84: 42.852796°N, 13.240533°E), ghiaia, 1,996 m, 19 July 2020, *F. Miconi* (FI). – Casual alien species new for the flora of Italy (Umbria).

A single plant of *Papaver orientale* bearing four flowers was found on gravelly soil. It was identified according to Cullen (1995).

F. Miconi

***Passiflora incarnata* L. (Passifloraceae)**

+ (CAS) **LAZ**: Tuscania (Viterbo), Via XI Febbraio, lungo il muro del campo di calcio (WGS84: 42.420996°N, 11.870770°E), base di muro, 180 m, 13 July 2020, *S. Magrini* (FI). – Casual alien species new for the flora of Lazio.

Several plants of the species grow along a wall, having probably escaped from nearby gardens; they produce many fruits every year.

S. Magrini, S. Buono

***Phyllostachys aurea* Carrière ex Rivière & C.Rivière (Poaceae)**

+ (CAS) **LAZ**: Latina (Latina), loc. Astura, lungo la sponda sinistra del Torrente Astura, a monte del ponte della SP106b (WGS84: 41.423738°N, 12.774910°E), area di ripa incolta occupata nella porzione basale da *Phragmites australis*, 1 m, 4 January 2020, *S. Ravetto Enri, M. Pittarello, M. Lonati* (FI). – Casual alien species new for the flora of Lazio.

A large population of this species, occupying an area of approximately 10×10 m, has been observed along a scarp of the Astura stream. The expansion probably occurred through leptomorph underground rhizomes. A recent project (BampApp 2020+) provided comprehensive information for evaluating and updating the presence of bamboo species in Piemonte and Valle d'Aosta, and a similar approach could be replicated to increase current knowledge regarding the status of bamboos in other Italian regions as well.

S. Ravetto Enri, M. Pittarello, M. Lonati

***Robinia hispida* L. (Fabaceae)**

+ (CAS) **ABR**: L'Aquila (L'Aquila), presso il Parco del Sole (WGS84: 42.341639°N, 13.403482°E), incolto, 680 m, 12 May 2020, *F. Conti, V. Giacanelli* (FI, APP). – Casual alien species new for the flora of Abruzzo.

F. Conti, V. Giacanelli, F. Bartolucci

***Sedum palmeri* S.Watson (Crassulaceae)**

+ (CAS) **ABR**: Teramo (Teramo), Via A. De Gasperi (WGS84: 42.662222°N, 13.708197°E), muro di contenimento in cemento situato al di sotto della sede stradale, ca. 256 m, S, 20 April 2020, *N. Olivieri* (FI). – Casual alien species new for the flora of Abruzzo.

Some individuals have settled on the rough surface of a vertical south-facing wall, which is, however, partially shaded by buildings.

N. Olivieri

***Siphonostylis unguicularis* (Poir.) Wern.Schulze (Iridaceae)**

+ (NAT) **ABR**: Atri (Teramo), margine stradale di Via D. Tinozzi (WGS84: 42.580874°N, 13.986662°E), scarpata a vegetazione ruderale con presenza di *Robinia pseudoacacia, Sambucus nigra, Laurus nobilis* e vegetazione erbacea nitrofila, 400 m, 29 January 2020, *J. Lupoletti, A. Pica* (FI). – Naturalized alien species new for the flora of Abruzzo.

Several individuals of different ages grow in an area of approximately 80 m^2. The surrounding areas and closest gardens do not host the species.

J. Lupoletti, A. Pica

***Sisyrinchium montanum* Greene (Iridaceae)**

+ (CAS) **MAR**: Apecchio (Pesaro e Urbino), Serre della Stretta, margine settentrionale del Bosco della Brugnola lungo la Strada Provinciale Pianditebbio (WGS84: 43.559302°N, 12.463115°E), luoghi acquitrinosi, ca. 600 m, 10 May 2020, *L. Gubellini, N. Hofmann* (FI, PESA). – Casual alien species new for the flora of Marche.

This neophyte is native to North America (Banfi and Galasso 2010; Cholewa and Henderson 2002). The small recorded population consists of about 10 individuals, and it grows in a grassy wet depression of a high hilly area.

L. Gubellini, N. Hofmann

***Viola sororia* Willd. (Violaceae)**

+ (CAS) **MAR**: Cagli (Pesaro e Urbino), loc. Case San Pietro (WGS84: 43.541383°N, 12.654030°E), siepe camporile e fessure del ciottolato di sentiero e capezzagna, 300 m, 6 April 2020, leg. *G. Mei*, det. *G. Mei, A. Stinca* (FI, PORUN-Stinca, *Herb. G. Mei*); *ibidem* (WGS84: 43.541230°N, 12.653035°E), suolo rimaneggiato, 285 m, 12 April 2020, leg. *G. Mei*, det. *G. Mei, A. Stinca* (PORUN-Stinca, *Herb. G. Mei*). – Casual alien species new for the flora of Marche.

G. Mei, A. Stinca

***Viola wittrockiana* Gams ex Nauenb. & Buttler (Violaceae)**

+ (CAS) **TOS**: Empoli (Firenze), Via E. Fermi (WGS84: 43.712452°N, 10.952261°E), circa 10 piantine sfuggite a coltura dalle abitazioni vicine, 25 m, 10 May 2020, *F. Roma-Marzio, P. Liguori* (FI). – Casual alien species new for the flora of Toscana.

F. Roma-Marzio

***Wisteria sinensis* (Sims) DC. (Fabaceae)**

+ (CAS) **SIC**: Misilmeri (Palermo), SP38 (WGS84: 38.052065°N, 13.434617°E), bordo strada, 239 m, 15 June 2020, *F. Scafidi* (FI). – Casual alien species new for the flora of Sicilia.

Some individuals of the species were also found, probably originated by vegetative propagation from plants cultivated nearby.

F. Scafidi, G. Barone, E. Di Gristina

***Yucca gigantea* Lem. (Asparagaceae)**

+ (CAS) **CAL**: Reggio Calabria (Reggio Calabria), fraz. Catona, ex Centro Svizzero (WGS84: 38.185560°N, 15.636418°E), incolto, 4 m, 7 January 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO). – Casual alien species new for the flora of Calabria.

The observed individual probably escaped from cultivation after being thrown away with waste material.

V.L.A. Laface, C.M. Musarella, G. Spampinato

Nomenclatural and distribution updates from other literature sources

Nomenclatural, status, distribution updates, and corrections to Galasso et al. (2018) are provided in Suppl. material 1.

G. Galasso, F. Bartolucci

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Supplementary material 1

Supplementary data

Authors: Gabriele Galasso, Fabrizio Bartolucci

Data type: Species data

Explanation note: 1. Nomenclatural updates; 2. Note updates; 3. Distribution updates; 4. Synonyms, misapplied or included names.

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RESEARCH ARTICLE

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Global and Regional IUCN Red List Assessments: 10

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Abstract

In this contribution, the conservation status assessment of two vascular plants according to IUCN categories and criteria is presented. It includes the regional assessment of *Jasione orbiculata* Griseb. ex Velen. for Italy and of *Vachellia gerrardii* (Benth.) P.J.H.Hurter subsp. *negevensis* (Zohary) Ragup., Seigler, Ebinger & Maslin for Iraq.

Keywords

Conservation, extinction risk, IUCN protocol, threats

How to contribute

The text of the global and regional assessments should be submitted electronically to Simone Orsenigo (simone.orsenigo@unipv.it) or to Giuseppe Fenu (gfenu@unica.it); the text, up to 8,000 characters in length (spaces included), must include a distribution map and a picture of the assessed species.

Red List Assessments

Jasione orbiculata Griseb. ex Velen.

Regional assessment (Italy)
Taxonomy and nomenclature
Order: Asterales *Family*: Campanulaceae

Jasione orbiculata Griseb. ex Velen., Fl. Bulg. 375 (1891) ≡ *Jasione laevis* Lam. subsp. *orbiculata* (Griseb. ex Velen.) Tutin, Bot. J. Linn. Soc. 70: 18 (1975) = *Jasione supina* Sieber ex Spreng. var. *hirsuta* Wettst., Biblioth. Bot. 26: 75 (1892) = *Jasione orbiculata* var. *balcanica* Urum., Österr. Bot. Z. 49: 56 (1899) = *Jasione orbiculata* var. *bosniaca* Stoj., Notizbl. Bot. Gart. Berlin-Dahlem 9: 553 (1926) = *Jasione orbiculata* var. *italica* Stoj., Notizbl. Bot. Gart. Berlin-Dahlem 9: 554 (1926) = *Jasione orbiculata* var. *supinoides* Stoj., Notizbl. Bot. Gart. Berlin-Dahlem 9: 554 (1926).

Common name: Orbicular Sheep's Bit (En), Vedovella della Basilicata (It).

Geographic distribution range: *Jasione orbiculata* (Fig. 1) is a rare species with a Balkan-Apennine-Dacian distribution, described by Velenovsky in Flora Bulgarica (Velenovsky 1891), and mentioned from Macedonia (Kobelitza, Peristeri) and Bithynian Olympus (Uludağ) (Grisebach 1844). In Italy (Fig. 2), it occurs only in a restricted area of Sirino-Papa Massif (Conti and Di Pietro 2004), falling within the province of Potenza in the Administrative Region of Basilicata, more precisely at "Schiena d'Asino" (Porta 1879, as *J. supina*), Madonna di Sirino (Cavara and Grande 1913), and Mt. Papa (APP-Herbarium Apenninicum, BEOU-Belgrade Herbarium, leg. F. Conti, D. Lakusic et Ph. Küpfer 25 July 1999) (Conti and Di Pietro 2004). The Schiena d'Asino and Mt. Papa sites were confirmed by personal observations of E.V. Perrino. The extreme rarity of the species is confirmed by detailed studies in the Sirino-Papa massif (Tomaselli et al. 2007), which do not report *J. orbiculata*.

Distribution: *Countries of occurrence*: Albania, Bulgaria, Greece, Italy, Macedonia, Montenegro, Romania, and Turkey.

Biology: *Plant growth form*: perennial (chamaephyte).

Chromosome number: $2n = 12$ (material from Macedonia, Gadella and Kliphuis 1972).

Flowering time: From June to August.

Reproduction: Entomophilous pollination. At maturity, the dehiscent capsule opens by means of an apical fissure and scatters the seeds (dissemination by balistochory).

Habitat and Ecology: *Jasione orbiculata* grows on rocky meadows and gravel. Its presence seems to be linked to the rare outcrops of siliceous substrates at high altitudes (1800–2000 m a.s.l.), while it is absent where the soil is calcareous with flint. The annual average precipitation is >1400 mm, while the bioclimate is oceanic temperate of the humid upper-supratemperate type (Tomaselli et al. 2006).

Figure 1. *Jasione orbiculata* Griseb. ex Velen. at M. Papa. Photograph by EnricoV. Perrino.

Figure 2. Geographic range and distribution map of *Jasione orbiculata* Griseb. ex Velen. in Italy.

Population information: There is no detailed information available on population dynamics.

Threats: *2.3.2 Small-holder grazing, ranching or farming*: Over-grazing is a threat. In fact, although no increase in grazing has been observed for 20 years, it should be noted that the cattle farms immediately adjacent to the two confirmed sites have increased their grazing area. Moreover, the increasing demand for goat products constitutes a serious problem because goats prefer the rocky environments where this species grows.

5.2.1 Gathering terrestrial plants (intentional use): The species could be affected by collection for its beauty during the flowering period and for scientific purposes by botanists.

7.3. Other ecosystems modifications: Vegetation dynamics can originate habitat variations, which are unfavorable for the plant.

10.3 Avalanches/landslides: This species grows on rocky meadows and gravel and is subject to landslides.

CRITERIA APPLIED:

Criterion B: **EOO**: 4 km^2

AOO: 4 km^2 calculated with a 2 × 2 km cell fixed grid.

a) Number of locations: The populations occur in a very restricted area. Nevertheless, it is possible to identify two locations, both affected by over-grazing, which represents the main threat affecting the species.

b) Due to recent increase in grazing, a continuing decline in number of mature individuals (v) is expected.

Red List category and Criteria (Regional Assessment)

EN	**Endangered**	**B1ab(v)+2ab(v)**

Rationale for the assessment: *Jasione orbiculata* is a NE-Mediterranean species, that grows in southern Italy (only in the Basilicata Region). Given the very restricted area of occurrence and population size, and the detected threats expected to affect the species in the near future, the species is considered Endangered (EN).

Previous assessment: This species was previous evaluated as Lower Risk (LR) at national and regional levels (Conti et al. 1997), and more recently as Data Deficient (DD) for Italy (Orsenigo et al. 2020).

Conservation actions: *Jasione orbiculata* is unprotected by international, national and regional laws. The Italian population sites are included in two Natura 2000 sites: "Monte Sirino" (SAC IT9210200) and "Appennino Lucano, Valle Agri, Monte Sirino, Monte Raparo" (SPA IT9210271).

Conservation actions needed: Research activities and a monitoring programme are recommended in order to better understand the reproductive biology of the species and the population trend. Moreover, *in situ* and *ex situ* conservation actions are recommended, for possible plant translocation programmes, aimed at increasing the low number of individuals of the population. Finally, it would be interesting to evaluate the ecological and genetic affinities between the East-European and Italian populations.

Notes: The Italian and Romanian populations are the most threatened (the species is listed as Critically Endangered in Romania; Bartók 2014), probably as here this species reaches the distribution limits of its range.

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Vachellia gerrardii (Benth.) P.J.H.Hurter subsp. *negevensis* (Zohary) Ragup., Seigler, Ebinger & Maslin

Regional assessment (Iraq)
Taxonomy and nomenclature
Order: Fabales *Family*: Fabaceae

Vachellia gerrardii subsp. *negevensis* (Zohary) Ragup., Seigler, Ebinger & Maslin, Phytotaxa 162(3): 176 (2014) ≡ *Acacia gerrardii* Benth. subsp. *negevensis* Zohary, Israel J. Bot. 13: 39 (1964).

Common name: Talh, Talha (Arabic, طلح، طلحة).

Geographic distribution range: *Vachellia gerrardii* subsp. *negevensis* (Fig. 3) is a tree with irregular distribution from the eastern Mediterranean area to south-western Asia, but the current distribution is still uncertain. In Iraq, there is a single population, with five scattered subpopulations distributed in the Al-Najaf province (Fig. 4). This plant occurs at Birkat Al-Talhat, and along Abu Talah (mid and terminal parts) and Weier (initial and terminal parts) streams (Al-Rammahi and Mohammad 2020). It is the only native *Vachellia* in Iraq (Townsend 1968).

Distribution: Countries of occurrence: Iraq, Israel, Jordan, Kuwait (doubtful), [Palestine], and Saudi Arabia (doubtful).

Biology: *Plant growth form*: Perennial (scapose phanerophyte).

Flowering and fruiting time: Flowering from April to December and fruiting from October to February.

Reproduction: The pollination system has not been studied in detail, but many insects may play a role as pollinators (e.g., *Apis mellifera*, *Belenois aurota*, *Colotis fausta*, and *Eupeodes corolla*). Natural dispersal strategy and seed germination have not been studied yet.

Habitat and Ecology: *Vachellia gerrardii* subsp. *negevensis* is a tree up to 11 m high (often 4–5 m) growing on flat ground gathering mud sediments coming from the neighboring heights as in Birkt Al-Talhat, and at the muddy base of large wadis in the other sites. The climate is characterized by hot summers and cool winters. Although precipitation is scarce (100–150 mm/year), the region receives transitory violent rainstorms in winter (Al-Rammahi and Mohammad 2020).

Population information: There is no detailed information available on population dynamics; however, an overall monitoring carried out in 2019 shows that the population growing in the Al-Najaf Desert consists of 287 mature trees, 128 of which, even though they bloom, do not produce seeds.

Threats: *2.3.1 Nomadic grazing*: large herds of sheep, goats and camels graze randomly and affect the seedlings of the Talh tree.

3.2 Mining & quarrying: Sand and gravel quarries that provide construction works with raw material are present in the sites where the population grows.

4.1 Roads & railroads: an increasing number of 4WD off-road civilian cars use unpaved pathways among the Talh stands causing a reduction in seedling recruitment.

Figure 3. *Vachellia gerrardii* subsp. *negevensis* at Birkat Al-Talhat, Al-Najaf desert, Iraq. Photograph by Mohmmad K. Mohammad.

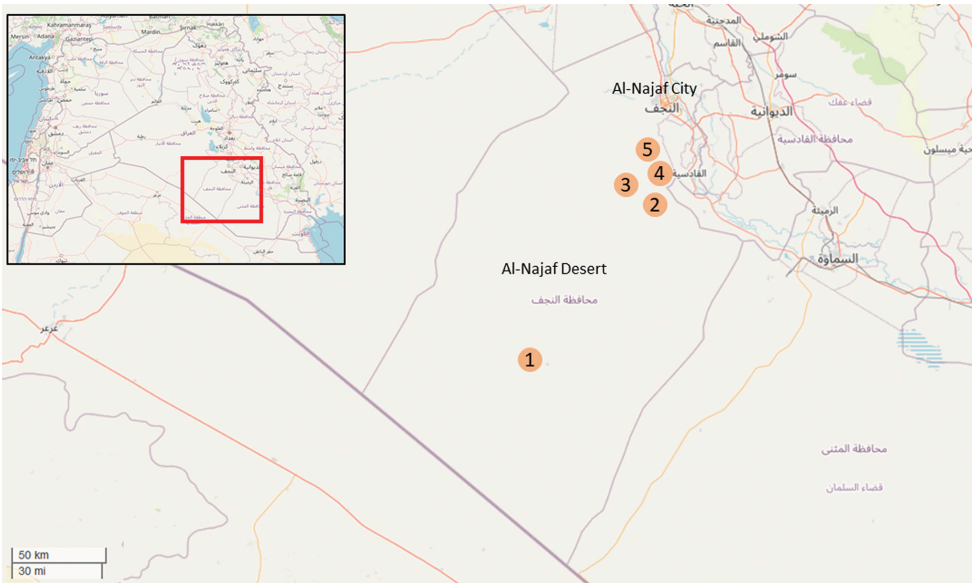

Figure 4. Geographic range and distribution map of *Vachellia gerrardii* subsp. *negevensis* in Iraq. Sub-populations: 1 = Birkat Al-Talhat, 2–3 = Abu Talah stream (mid and terminal parts), and 4–5 = Weier stream (initial and terminal parts).

There is a security ground trench at the Abu Talah stream that crosses the *Vachellia gerrardii* subsp. *negevensis* site and disturbs the natural flow of rainwater.

5.3 Logging & wood harvesting – 5.3.2: *Intentional use – large scale*: local population (Bedouins) and tourists frequently cut the main stem with the branches for fuel needs and out of 287 mature trees, 124 were recently damaged.

6.2 War, civil unrest & military exercises: continuous military activities are present in the population area.

8 Invasive & other problematic species, genes & diseases – 8.1.2 Named species: the invasive alien *Vachellia farnesiana* (L.) Wight & Arn., which is considered an aggressive colonizer, has been found in the population area.

8.2 Problematic native species/diseases – 8.2.2 Named species: the beetle *Caryedon gonagra* infests Talh seeds; observations on the seeds collected in the field indicates that > 90% of them were infested (Al-Rammahi and Mohammad 2020).

11 Climate change & severe weather (Droughts, Temperature extremes, and Storms & flooding): the rate of precipitation in the Al-Najaf desert is very low leading to severe water shortage. Conversely, recurrent floods due to stormy rains result in uprooting of some trees.

CRITERIA APPLIED:

Criterion B: **EOO:** 680.73 km^2 calculated with GeoCAT (Geospatial Conservation Assessment Tool) software (Bachman et al. 2011).
AOO: 72 km^2 calculated with GeoCAT software (Bachman et al. 2011).

a) Number of locations: we identified five locations based on the main threat (5.3.2: Intentional use).
b) Due to the severe threats observed, habitat quality (iii) is declining in all sites, as well as the number of mature individuals (v). A reduction of EOO (i) and AOO (ii) is likely to affect the species in the near future.

Criterion C: The population is composed of less than 2,500 mature individuals, subjected to a continuous decline; no subpopulation has more than 250 mature individuals.

Criterion D: The Iraqi population consists of 287 mature trees, 128 of which, even though they bloom, do not produce seeds.

Red List category and Criteria (Regional Assessment)

EN	**Endangered**	**B1ab(i,ii,iii,v)+2ab(i,ii,iii,v) + C2a(i) + D**

Rationale for the assessment: *Vachellia gerrardii* subsp. *negevensis* is restricted to a single population in Iraq located in the desert of Al-Najaf, with five subpopulations affected by several severe threats. The EOO is less than 5,000 km^2, the AOO is less than 500 km^2, and according to the main threat, we can identify five locations as well as a continuous decline in EOO, AOO, habitat quality and number of mature plants. In addition, the population is composed of 287 mature individuals, but according to updated guidelines (IUCN 2019) the population size must be considered equal to 159 mature individuals. No subpopulation has more than 250 mature individuals. According to criteria B, C, and D this taxon can be assessed as Endangered (EN) at regional level. Because geographical isolation makes any contribution of the populations occurring in neighboring countries to the conservation status of the Al-Najaf one unlikely, there is no reason for up- or down-grading the risk category resulting from this assessment procedure.

Previous assessment: This taxon is not evaluated (NE) at the global level (IUCN 2020).

Conservation actions: At present, there are no conservation measures for this species.

Conservation actions needed: It would be important to declare the Talh tree distribution area as a national nature reserve to protect it legally. This action will bring ecotourism to the area, with benefits for the local people in terms of additional income, encouraging them to protect this sustainable resource.

Notes: Phenotypic similarities between closely related *Vachellia* species make taxonomic distinction quite difficult, especially when species distributions overlap, as is the case in the Middle East and the Arabian Peninsula. Currently, it is accepted that *Vachellia gerrardii* subsp. *negevensis* also includes *V. iraqensis* described by Rechinger (1964). Recently, new names in the genus *Vachellia* for many taxa formerly included in *Acacia* subg. *Acacia* were proposed, whereby *Acacia gerrardii* subsp. *negevensis* is now called *Vachellia gerrardii* subsp. *negevensis* (Ragupathy et al. 2014).

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RESEARCH ARTICLE

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Notulae to the Italian flora of algae, bryophytes, fungi and lichens: 10

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Abstract

In this contribution, new data concerning red algae, bryophytes, fungi and lichens of the Italian flora are presented. It includes new records and confirmations for the algal genus *Thorea*, for the bryophyte genera *Ephemerum*, *Hedwigia*, *Pogonatum*, *Riccia*, *Sphagnum*, and *Tortella*, the fungal genera *Pileolaria* and *Sporisorium*, and the lichen genera *Bacidia*, *Cerothallia*, *Chaenotheca*, *Cladonia*, *Halecania*, *Lecanora*, *Phylloblastia*, *Physcia*, *Protoparmelia*, *Pycnora*, *Segestria*, and *Sphaerophorus*.

Keywords

Ascomycota, Basidiomycota, Bryidae, Marchantiidae, Rhodophyta

How to contribute

The text of the records should be submitted electronically to: Cecilia Totti (c.totti@univpm.it) for algae, Marta Puglisi (mpuglisi@unict.it) for bryophytes, Alfredo Vizzini (alfredo.vizzini@unito.it) for fungi, Sonia Ravera (sonia.ravera@unipa.it) for lichens.

Floristic records

ALGAE

Thorea hispida (Thore) Desvaux (Thoreaceae)

+ **PIE**: Tanaro River, Castello di Annone (Asti), shallow water on river side, moderate flow, (UTM WGS84: 32T 445180.4969789), 108 m, 19 September 2013, *V. Pizzo, S. Vazzola*, conf. *R. Bolpagni*; Bormida di Millesimo River, Cortemilia (Cuneo), shallow water, moderate flow (UTM WGS84: 32T 431783.4932315), 250 m, 14 August 2014, *E. Gastaldi, V. Pizzo, S. Vazzola*; Marcova torrent, Motta De' Conti (Vercelli), shallow

water, moderate flow (UTM WGS84: 32T 463903.5002336), 100 m, 16 July 2015, *V. Pizzo V., S. Vazzola*; Tanaro River, Castello di Annone (Asti), shallow water on river side, moderate flow, (UTM WGS84: 32T 445180.4969789), 108 m, 13 July 2016, *V. Pizzo, S. Vazzola* (Herbarium ARPA Piemonte – Dipartimento territoriale Piemonte sud est); Tanaro River, Felizzano (Alessandria), shallow water on river side, moderate flow (UTM WGS84: 32T 455731.4970930), 95 m, 13 July 2016, *V. Pizzo, S. Vazzola* (Herb. ARPA Piemonte – Dipartimento territoriale Piemonte sud est); Tanaro River, San Martino Alfieri (Asti), shallow waters on river side, moderate flow (UTM WGS84: 32T 431600.4963158), 128 m, 21 July 2016, *V. Pizzo, S. Vazzola* (Herbarium ARPA Piemonte – Dipartimento territoriale Piemonte sud est); Roggia Bona torrent, Caresana (Vercelli), shallow water, moderate flow (UTM WGS84: 32T 461394.5008232), 100 m, 6 October 2016, *V. Pizzo, S. Vazzola*; Sesia River, Motta De' Conti (Vercelli), shallow water on river side, moderate flow (UTM WGS84: 32T 464813.5004710), 100 m, 12 October 2016, *V. Pizzo, S. Vazzola* (Herbarium ARPA Piemonte – Dipartimento territoriale Piemonte sud est); Bormida di Millesimo River, Cortemilia (Cuneo), shallow water, moderate flow (UTM WGS84: 32T 431783.4932315), 250 m, 3 October 2018, *E. Gastaldi*, *V. Pizzo, S. Vazzola*; Tanaro River, Castello di Annone (Asti), shallow water on river side, moderate flow, (UTM WGS84: 32T 445180.4969789), 108 m, 5 August 2019, *V. Pizzo, S. Vazzola*; Tanaro River, San Martino Alfieri (Asti), shallow waters on river side, moderate flow (UTM WGS84: 32T 431600.4963158), 128 m, 5 August 2019, *V. Pizzo, S. Vazzola*; Tanaro River, Felizzano (Alessandria), shallow water on river side, moderate flow (UTM WGS84: 32T 455731.4970930), 95 m, 8 August 2019, *V. Pizzo, S. Vazzola*. – Species new for the flora of Piemonte.

Many new collections of *Thorea hispida* have been made in recent years from Europe: Simić and Pantović (2010), Simić et al. (2014) for Serbia; Vitonytė (2011) for Lithuania; Cărăuş (2012) for Romania; Tomás et al. (2013) for Spain. This is likely the result of the implementation of the Water Framework Directive, that imposed an overall review and updating of knowledge on neglected macroscopic primary producers in freshwater ecosystems, such as red algae (Ceschin et al. 2012, 2013). Despite this renewed interest, this species remains poorly documented, especially regarding its ecological preferences (Vitonytė 2011, García and Aboal 2014). Thoreales are common in tropical and subtropical areas (Sheath and Hambrook 1990, Sheath et al. 1993, Carmona and Necchi 2001) and are considered rare and threatened in Europe (Eloranta et al. 2011). Accordingly, *T. hispida* is included in the Algae Red List in some European countries (Ludwig and Schnittler 1996, Sheliag-Sosonko 1996, Simienska 2006, Simić et al. 2007, Temniskova et al. 2008, Täuscher 2010), and it is still considered a species with a very restricted distribution (García and Aboal 2014 and references therein). In Italy, it was reported for the first time in Lombardia (northern Italy) in the Oglio River, a mid-size and nutrient-rich tributary of the Po River, where a seasonal monitoring study conducted during 2009–2011 revealed that a 40 km stretch hosted three *T. hispida* populations (Bolpagni et al. 2015). *Thorea hispida* is commonly associated to nutrient-rich waters.

S. Vazzola, D. Bouvet, A. Rossi

BRYOPHYTES

Ephemerum recurvifolium (Dicks.) Boulay (Pottiaceae)

+ **TAA**: Municipality of Montagna/Montan (Bolzano/Bozen-Südtirol) (UTM WGS84 32T 677213.5133744), 430 m, 15 May 2019, leg. *S. Stifter, A. Hilpold*, det. *D. Spitale* (Herbarium BOZ). – Species new for the flora of Trentino-Alto Adige.

Ephemerum recurvifolium is a submediterranean-euryatlantic species quite rare in Europe, where it is considered at risk in many countries (Hodgetts and Lockhart 2020) and listed as Near Threatened in the new IUCN European Red List (Hodgetts et al. 2019). In Italy it occurs in five administrative regions, Piemonte, Umbria, Campania, and Sicilia, and was recorded before 1968 in Toscana and Sardegna (Aleffi et al. 2020). In the new locality, *Ephemerum recurvifolium* was found in an apple orchard managed with Integrated Farming practices. Associated species were *Amblystegium serpens* (Hedw.) Schimp., *Kindbergia praelonga* (Hedw.) Ochyra, *Plagiomnium cuspidatum* (Hedw.) T.J.Kop., and *Brachythecium campestre* (Müll.Hal.) Schimp. In South Tyrol, this species is not listed in the new bryophyte database (FloraFaunaSüdtirol 2014). Like the other members of the genus it can be easily overlooked because of its small size. It is distinguished from the much more common *Ephemerum serratum* (Hedw.) Hampe and *Ephemerum minutissimum* Lindb. for its more strongly toothed leaves, showing no or very faint midrib. On suitable sites, this species grows on bare, moist soils often on calcareous clay in arable fields (Dierßen 2001), or on surfaces within grassy patches, which probably protect the persistent protonema from damage (Novotný 1986).

D. Spitale, S. Stifter, A. Hilpold

Hedwigia emodica Hampe ex Müll.Hal. (Hedwigiaceae)

+ **LIG**: Frisolino, Ne (Genova), path to the Miniera di Molinello, on red jasper (UTM WGS84: 32T 536605.4910320), 248 m, 5 January 2015, leg. *G. Barberis*, det. *G. Barberis*, *D. Dagnino, C. Turcato* (GE B180). – Species confirmed for the flora of Liguria.

Hedwigia emodica was reported for Italy by Aleffi et al. (2008) as *Hedwigia ciliata* (Hedw.) P.Beauv. var. *leucophaea* Bruch. & Schimp. for Piemonte, Trentino-Alto Adige, and Sardegna and, with old reports, for Val d'Aosta, Lombardia, Liguria, Toscana, Calabria, and Sicilia. Later, after a revision of specimens kept in the herbaria of Firenze (FI) and Pisa (PI), this species was reported also for Veneto, Emilia-Romagna, and Umbria (Puglisi et al. 2013). In particular, *H. emodica* has not been found in Liguria since the second half of the 19th century, when it was indicated for "apennino Genuensis" (De Notaris 1869) and for M. Penna (Fleischer 1893). It is a suboceanic boreo-temperate species, quite rare in the Mediterranean region, where it occurs in some countries as a single record (Ros et al. 2013).

G. Barberis, D. Dagnino, C. Turcato

Pogonatum aloides (Hedw.) P.Beauv. (Polytrichaceae)

+ **LIG**: Passo Cento Croci, Varese Ligure (La Spezia), mixed deciduous forest dominated by beech (UTM WGS84: 32T 549632.4918834), 1061 m, 7 October 2018, leg. *S. Peccenini*, det. *D. Dagnino, C. Turcato* (GE B167); Ronco Scrivia (Genova), along the "Cascinetta-Tegli" municipal road, coppice wood dominated by chestnut (UTM WGS84: 32T 493268.4937707), 475 m, 7 October 2018, leg. *D. Dagnino*, det. *D. Dagnino, C. Turcato* (GE B168). – Species confirmed for the flora of Liguria.

Pogonatum aloides occurs in most of the Italian regions (Aleffi et al. 2020) and Mediterranean countries (Ros et al. 2013), growing in a wide range of shady environments, from the basal to the alpine belt (Cortini Pedrotti 2001). Several records from the end of the 19th century suggest that this species was common in Liguria (Piccone 1863, Fitzgerald and Bottini 1881, Fleischer 1893), but it was no longer recorded for this region (Aleffi et al. 2020).

D. Dagnino, L. Minuto, C. Turcato

Riccia lamellosa Raddi (Ricciaceae)

+ **PUG**: Contrada Samia, Torricella (Taranto), on dry soil, (UTM WGS 84 33T 712611.4466222), 25 m, 30 January 2020, *S. Gianfreda* (Herbarium Gianfreda). – Species new for the flora of Puglia.

Riccia lamellosa was found in a small olive tree grove, two kilometres from the Ionian Sea; the soil was not plowed and was covered by a large amount of mosses. The specimens are characterized by light green rosettes with lobes 2–3 mm wide, lateral wings narrow, hardly distinct, nearly horizontal in old parts; the spores are dark brown, 90–100(110) µm in diameter with wings about 5 µm wide. In Europe the species is widespread in the southern and Mediterranean countries (Hodgetts and Lockhart 2020); in Italy the only Regions where it was found are Trentino-Alto Adige, Toscana, Campania, Sardegna, and Sicilia (Aleffi et al. 2020).

S. Gianfreda, C. Matino

Sphagnum molle Sull. (Sphagnaceae)

+ **FVG**: Malga Plotta, Carnic Alps, Paluzza (Udine), in a small bog next to the forest road which leads from the Marinelli Refuge to the Pass of Monte Croce Carnico (UTM WGS84: 33T 339914.5162098), 1847 m, 12 July 2020, *F. Sguazzin, A. Boemo* (Bryophytorum Herbarium F. Sguazzin). – Species confirmed for the flora of Friuli-Venezia Giulia.

Sphagnum molle is a suboaceanic-temperate species; it is mostly distributed in northern and central Europe, where it is considered at risk of extinction in many coutries (Hodgetts and Lockhart 2020). It is known in Italy, with reports published after 1950, for Piemonte, Veneto, and Trentino-Alto Adige and, with older records,

for Lombardia and Friuli-Venezia Giulia (Aleffi et al. 2008, 2020). As regards Friuli-Venezia Giulia (Sguazzin 2011), the only finding refers to Carnic Alps, and dates back more than a century (Kern 1908). In Italy, all *Sphagnum* species are threatened with extinction, but are included in the category Data Deficient (DD), because of their insufficient distribution knowledge (Rossi et al. 2013). According to Laine et al. (2018), this species grows in poor fens, along lake shores, wet heath margins, and sand dunes.

F. Sguazzin, A. Boemo

Tortella mediterranea Köckinger, Lüth O.Werner & Ros (Pottiaceae)

+ **ITALIA** (**TOS**): Solco d'Equi, Apuan Alps Regional Park, Fivizzano (Massa Carrara), on sunny and dry (occasionally shaded and humid), vertical to inclined marble rocks at the edge of the road (UTM WGS84: 32T 593317.4890377), 396 m, 4 March 2020, *G. Pandeli* (Herb. Pandeli, Herb. Köckinger, GZU); Lizza della Canalonga, Apuan Alps Regional Park, Valle di Vinca, Fivizzano (Massa Carrara), marble and limestone outcrops above the path (UTM WGS84: 32T 591507.4888129), 355 m, 4 March 2020, *G. Pandeli* (SIENA). – Species new for the flora of Italy (Toscana).

Tortella mediterranea is a Mediterranean species recently described from the limestone gorges and crags of the mountainous regions of Mallorca, Greece, Croatia, and Montenegro from areas with a rather high level of annual precipitation. It differs from similar taxa, like *Tortella nitida* (Lindb.) Broth. and *Tortella tortuosa* (Hedw.) Limpr., by a characteristic combination of character-states according to Köckinger et al. (2018), see Suppl. material 1. This species proved locally abundant, but no sporophyte- nor gametangia-bearing material was detected. The populations can be found along the paths of Lizza della Canalonga and Solco d'Equi (Apuan Alps Regional Park), on vertical marble and limestone outcrops occupied by *Homalothecium lutescens* (Hedw.) H.Rob., *Schistidium crassipilum* H.H.Blom, *Ctenidium molluscum* (Hedw.) Mitt., *Tortella nitida* (Lindb.) Broth. var. *irrigata* (H.Winter) R.H.Zander, *Exsertotheca crispa* (Hedw.) S.Olsson, Enroth & D.Quandt, *Trichostomum crispulum* Bruch, and *Tortella squarrosa* (Brid.) Limpr. Because of the frequency of environmentally similar habitats in the area, *T. mediterranea* could be present also in other localities of the Apuan Alps.

G. Pandeli, H. Köckinger, I. Bonini

FUNGI

Pileolaria terebinthi (DC.) Castagne (Pileolariaceae)

+ **BAS**: Castelmezzano (Potenza), hypophyllous on leaves of *Pistacia terebinthus* L. (UTM WGS84: 33T 588716.4486225), 687 m, 20 October 2019, *D. Puntillo* (CLU No. 406). – Species new for the flora of Basilicata.

Considered for a long time a hemi-form (II, III, IV stage) or brachy-form rust species (0, II, III, IV), it is instead an automacrocyclic species (0, I, II, III, IV) as

demonstrated by Abbasi (2018). Its aecial state is not uredinoid, as it was believed. *Pileolaria terebinthi* was cited as new for Italy by Berlese (1896), who recorded it on leaves of *Pistacia vera* L. in the Botanical Garden of University of Camerino, then it was reported from the Botanical Garden of Padova under the name *Uredo terebinthi* DC. (Saccardo 1872), from Veneto, Lombardia, Liguria, Marche, Lazio, Puglia (Trotter 1908, under the name *Uromyces terebinthi* (DC.) G.Winter) and also from Etna in Sicilia (Scalia 1915, under the name *Uromyces terebinthi*).

D. Puntillo

Sporisorium reilianum (J.G.Kühn) Langdon & Full. (Ustilaginaceae)

+ **CAL**: Monasterace Marina near the archaeological excavations of Caulonia (Reggio Calabria), on flowers of *Sorghum halepense* (L.) Pers. (UTM WGS84: 33S 637874.4257027) 4 m, 22 August 2014, *D. Puntillo* (CLU No. 404). – Species new for the flora of Calabria.

Sori are located in *Sorghum* inflorescences, which are usually destroyed and transformed into a grainy-powdery blackish-brown sporal mass. This species also grows also on *Zea mays* L., but it is less common than *Ustilago maydis* (DC.) Corda. *Sporisorium cruentum* (J.Kühn) K.Vánky is very similar, but it stands out with its smooth spores, while in *Sporisorium sorghi* C.G.Ehrenberg ex H.F.Link the sori infect the ovaries. *Sporisorium reilianum* is a subcosmopolitan species. In Italy, Rivolta (1873) reported the species under the name *Ustilago holci-sorghi* Rivolta for Grosseto (Toscana). Ciferri (1938) listed the species under the name *Sphacelotheca holci-sorghi* Cif. for Campania, Emilia-Romagna, Lazio, Lombardia, Sicilia, Trentino-Alto Adige, and Veneto. Recently, Tommasi (2006) reported the species for Friuli Venezia Giulia.

D. Puntillo

LICHENS

Bacidia igniarii (Nyl.) Oxner (Ramalinaceae)

+ **ABR**: Vallone Grascito, south of Sulmona (L'Aquila), on the bark of *Quercus pubescens* Willd. (UTM WGS84: 33T 414031.4652537), 568 m, 7 July 2020, leg. *L. Paoli, Z. Fačkovcová, S. Loppi, A. Vannini*, det. *L. Paoli, Z. Fačkovcová* (SAV). – Species new for the flora of Abruzzo.

This species generally grows on smooth barks, rarely on wood, and it is poorly known (Nimis 2016). The collected specimen has ascospores 3-septate, hyaline, bacilliform (15 × 2.5 µm); epithecium K-, olive green; hymenium mostly colourless; simple paraphyses; hypothecium colourless or very pale brown, K+ reddish.

L. Paoli, Z. Fačkovcová, S. Loppi

Cerothallia luteoalba (Turner) Arup, Frödén & Søchting (Teloschistaceae)

+ **ABR**: Vallone Grascito, south of Sulmona (L'Aquila), on the bark of *Quercus pubescens* Willd. (UTM WGS84: 413992.4652623), 564 m, 7 July 2020, leg. *L. Paoli, Z. Fačkovcová, S. Loppi, A. Vannini*, det. *L. Paoli, Z. Fačkovcová* (SAV). – Species new for the flora of Abruzzo.

This species often prefers dust-covered barks, especially old trunks of deciduous trees, and it was more frequent in the past, perhaps extinct in several parts of the country, especially in northern Italy (Nimis, 2016). The collected specimen is characterized by thallus K- and by the presence of numerous apothecia (diameter < 0.6 mm), with mostly orange disc K+ red, and slightly paler proper margin. The ascospores are 1-septate, polarilocular, hyaline, with thin septum (< 1/4 of the length of ascospores). The specimen was recorded together with *Caloplaca cerina* (Hedw.) Th.Fr. s.lat., *Catillaria nigroclavata* (Nyl.) J.Steiner, *Gyalolechia flavorubescens* (Huds.) Søchting, Frödén & Arup, and *Myriolecis hagenii* (Ach.) Sliwa, Zhao Xin & Lumbsch.

L. Paoli, Z. Fačkovcová, S. Loppi

Chaenotheca stemonea (Ach.) Müll.Arg. (Coniocybaceae)

+ **TOS**: Loc. Lago, Forest of Vallombrosa, Reggello (Firenze), on *Pinus* sp. (UTM WGS84: 32T 706990.4848314), 910 m, 24 June 2020, leg. *C. Cocozza, S. Ravera*, det. *S. Ravera* (Herb. Ravera); Forest of Vallombrosa, Reggello (Firenze), on Silver fir (*Abies alba* Mill.) standing dead tree (UTM WGS84: 32T 707245.4849062), 960 m, 8 October 2020, *S. Ravera* (Herb. Ravera). – Species new for the flora of Toscana.

Chaenotheca stemonea is a pin lichen with poorly developed excipulum, the lower part with a whitish pruina, 0.7–1.6 mm high, characterized by the photobiont (*Stichococcus*), the thin and farinose thallus and the almost globose capitulum. It is a cool-temperate to boreal-montane, circumpolar species, rare in the Italian montane belt, usually found on bark and wood of conifers, more rarely on deciduous trees in forested habitats (Nimis 2016). This specimen grows on the trunk of a single old tree, covering it completely up to approximately 2 m above the ground, along the course of a stream. *Chaenotheca stemonea* is included in the Italian Red List of epiphytic lichens, under the "Least Concern" category (Nascimbene et al. 2013).

S. Ravera, C. Cocozza

Cladonia macrophylla (Schaer.) Stenh. (Cladoniaceae)

– **TOS**. – Species to be excluded from the flora of Toscana.

Cladonia macrophylla is a an arctic-boreal species found only at high elevations in temperate Europe (Wirth et al. 2013), and occurring only in the Alps in Italy (Nimis et al. 2018). Nimis (1993) reported only a single record of this species from Toscana, originally published by Sambo (1927). However, Sambo (1927) reported «*Cladonia squamosa* var. *macrophylla* Rabenhorst», which is *Cladonia squamosa* Hoffm., and not

«*Cladonia alpicola* (Flot.) Vain.», the name used for *C. macrophylla* in the 1920s (see Ahti 1967). Therefore, *C. macrophylla* was never actually reported from Toscana. Furthermore, the record by Sambo (1927) should not even be referred to *C. squamosa*. No specimen by Sambo was found in FI (Munzi et al. 2019), albeit Sambo (1927) clearly stated that this species was identified by referring to a specimen collected by Emilio Rodegher and preserved in FI («*Cfr. hb. centr. Gen. Cladonia campione Val Brembana legit Rodegher*»). The only specimen found in FI and labelled as «*Cladonia squamosa* var. *macrophylla*» («*Valle Brembana (Bergamasco), Rodegher, Det. Dr. Jatta, ex herb. E. Baroni*») is a misidentified specimen of *Cladonia furcata* (Huds.) Schrad. subsp. *furcata*, showing many large squamules on podetia. Therefore, the record by Sambo (1927) should also probably be referred to a specimen of *C. furcata* with richly squamulose podetia.

G. Gheza, L. Di Nuzzo, J. Nascimbene

Halecania viridescens Coppins et P.James (Leprocaulaceae)

+ **ITALY** (**TAA**): Cavalese (Trento), on twig of *Fraxinus excelsior* L. (UTM WGS84: 32T 689644.5128933), 970 m, 13 December 2013, *J. Malíček* (Herb. Malíček no. 5342). – Species new for the flora of Italy (Trentino-Alto Adige).

Halecania viridescens is a crustose lichen with a fragile pale green to green-brown minutely warted-areolate thallus, dissolving into Pd+ orange-red soralia; few or absent gray to dark brown apotecia (to 0.4 mm broad). When sterile, it resembles *Scolicosporum sarothamni* (Vain.) Vězda, which usually does not form discrete soralia and is C+ reddish. However, both species are slightly variable and can occur in the same habitat, so that the Pd+ reaction of soralia in *H. viridescens* is an important diagnostic character. In temperate Europe, *Halecania viridescens* is widespread pioneer lichen in forests and agricultural landscape. It prefers slightly nitrophilous communities and smooth bark of young trunks, branches and twigs. This species is often associated with *Catillaria nigroclavata* (Nyl.) Schuler and *Candelariella efflorescens* agg. *sensu* Westberg and Clerc (2012). Due to its mainly sterile occurrence and small thalli, *Halecania viridescens* is an overlooked species and its real distribution and abundance are probably much larger than believed (Malíček et al. 2020).

J. Malíček

Lecanora marginata (Schaer.) Hertel & Rambold (Lecanoraceae)

+ **VEN:** Colle Cesta, near Vette Grandi Pass, Vette Feltrine, Dolomiti Bellunesi National Park (Belluno), on selciferous calcareous rocks (Formazione di Fonzaso) (UTM WGS84: 32T 719837.5107983), 2010 m, 12 July 2020, *J. Nascimbene* (Herb. Nascimbene JN6868). – Species confirmed for the flora of Veneto.

Lecanora marginata is a lichen with a crustose, continuous or rimose-areolate, yellowish to yellowish white thallus and lecideine apothecia shiny black, flat to convex, at first immersed, then subsessile. A thalline margin is present only in very young

apothecia and it is very soon excluded. The epithecium is typically green to dark blue-green or greenish black, reacting N+ red. The hymenium and the hypothecium are colourless. It is a circumpolar, arctic-alpine lichen, that in Italy is most frequent in the Alps (Nimis 2016), on limestone, dolomite, and on more or less calciferous siliceous rocks. The record reported here was collected on a selciferous carbonatic formation of the late Jurassic period. The last records from Veneto date back to the second half of the 19th century (Nimis 1993).

J. Nascimbene

Phylloblastia inexpectata Sérus., Coppins & Lücking (Verrucariaceae)

+ **CAL**: Bosco di Mavigliano, Montalto Uffugo (Cosenza), on cladodes of *Ruscus aculeatus* L. and *Hedera helix* L. leaves (UTM WGS84: 33S 604439.4360261), 223 m, 1 October 2020, *D. Puntillo* (CLU No. 17945, 17946). – Species new for the flora of Calabria.

Phylloblastia inexpectata is a foliicolous pyrenocarpous lichen species with Atlantic-Macaronesian distribution, also known from the British Isles and Madeira (Nimis 2016). In Italy, this species is known only for a warm-humid gorge located in Campania, where it was collected on *Buxus sempervirens* L. leaves (Sérusiaux et al. 2007). Its distribution is certainly underestimated, due to morphological characteristics. In fact, this species has an inconspicuous and very thin thallus, with a cortex formed by a single layer of cylindrical to irregular cells close to the perithecia, and very small flattened perithecia (0.1–0.15 mm in diameter). In the field, it is easily mistaken for a non-lichenized fungus. In the Mavigliano wood, we recorded a few others foliicolous species: *Fellhanera bouteillei* (Desm.) Vězda, *Porina hoehneliana* (Jaap) R.Sant., *Porina oxneri* R.Sant., *Bacidina vasakii* (Vězda) Vězda, and the lichenicolous fungus *Bryostigma muscigenum* (Th.Fr.) Frisch & G.Thor (Puntillo and Puntillo 2004).

D. Puntillo, M. Puntillo

Physcia dimidiata (Arnold) Nyl. (Physciaceae)

+ **SIC**: Roccafiorita (Messina), on limestone rocks at N-facing slope of a hill (UTM WGS84: 33S 523131.4198140), 880 m, 4 May 2012, *J. Malíček* (Herb. Malíček no. 6760). – Species new for the flora of Sicilia.

Physcia dimidiata is a narrow lobed foliose lichen, forming small irregular rosettes with overlapping lobes, crenulate and minutely lobulate at tips. It grows in rather rain-protected vertical and slight overhangs on epilithic substrates, as well as on artificial substrates and, occasionally, on basal parts of old trees with nutrient-rich, subneutral to moderately basic, often deeply cracked bark (Wirth et al. 2013). This lichen is a holarctic species with a Mediterranean to mild-temperate distribution in Europe, where it grows mostly below the montane belt (Nimis 2016).

J. Malíček, S. Ravera

Protoparmelia badia (Hoffm.) Hafellner (Parmeliaceae)

+ **VEN:** Colle Cesta, near Vette Grandi Pass, Vette Feltrine, Dolomiti Bellunesi National Park (Belluno), on selciferous calcareous rocks (Formazione di Fonzaso) (UTM WGS84: 32T 719837.5107983), 2010 m, 2 May 2000, *J. Nascimbene* (Herb. Nascimbene JN1318); Colle Cesta, near Vette Grandi Pass, Vette Feltrine, Dolomiti Bellunesi National Park (Belluno), on selciferous calcareous rocks (Formazione di Fonzaso) (UTM WGS84: 32T 719837.5107983), 2010 m, 12 July 2020, *J. Nascimbene* (Herb. Nascimbene JN6869). – Species confirmed for the flora of Veneto.

Protoparmelia badia is a crustose lichen with an olive-brown to gray-brown or dark brown rimose-areolate to warted thallus, chestnut brown to dark brown apothecia, at first immersed and later sessile, and one-celled (10–16 × 4–7 μm) spores with pointed apices. It is a heterogeneous species (Singh et al. 2015) with an Italian distribution mainly centered in the Alps (reaching the nival belt), where it is common on siliceous rocks. It is relatively rare in Mediterranean ranges (Nimis 2016). The records reported here were collected on nodules or flint layers included in a carbonatic, late Jurassic, formation that are typically colonized by silicicolous lichens (e.g., *Rhizocarpon geographicum* s.l.). The last records from Veneto date back to the second half of the 19th century (Nimis 1993).

J. Nascimbene

Pycnora sorophora (Vain.) Hafellner (Pycnoraceae)

+ **PIE**: Upper Valsesia, Rassa (Vercelli), ZPS "Alta Valsesia e Valli Otro, Vogna, Gronda, Artogna e Sorba", on old wooden fences not far from Torrente Gronda (UTM WGS84: 32T 423291.5068728), 960 m, 16 August 2020, *D. Isocrono* (Herbarium Isocrono). – Species new for the flora of Piemonte.

The genus *Pycnora*, formerly included in *Hypocenomyce* M.Choisy, was established in 2001 (Hafellner and Türk 2001) to separate crustose species with alectorialic acid and black pycnidia. Two of the four known species – *Pycnora sorophora* and *Pycnora praestabilis* (Nyl.) Hafellner – occur in Italy. *Pycnora sorophora* is a microlichen with areolate thallus and farinose yellowish brown soredia, often sterile, occurring on wood and on the bark of conifers. This species is widely distributed in boreal and temperate Europe but it is, so far, rarely reported in Italy only for eastern regions (Nimis 2016). It is included in the Italian Red List of epiphytic lichens as "Vulnerable" (Nascimbene et al. 2013).

D. Isocrono

Segestria leptalea (Durieu & Mont.) R.C.Harris (Porinaceae)

+ **TOS**: Forest of Vallombrosa, Reggello (Firenze), on bark of *Fagus sylvatica* L. (UTM WGS84: 32T 707245.4849025), 995 m, 23 June 2020, leg. *C. Cocozza, S. Ravera*, det.

S. Ravera (Herb. Ravera); Loc. Lago, Forest of Vallombrosa, Reggello (Firenze), on *Abies alba* Mill. (UTM WGS84: 32T 707000.4848230), 920 m, 7 October 2020, leg. *C. Cocozza, S. Ravera*, det. *S. Ravera* (Herb. Ravera). – Species new for the flora of Toscana.

Segestria leptalea is a crustose Pyrenocarpales, characterized by crowded brownish orange (not black, as more common in Pyrenocarpales) perithecia 0.1–0.3 mm across, partly immersed. In central Europe, it is typical for temperate beech forests, including mountain beech forests (J. Malíček pers. comm.). This species prefers old-growth forests, but it can occur also in managed ones, which are close to some old-growth forests. In Italy – where it is known only for Basilicata (Bartoli and Puntillo 1998) and Calabria (Puntillo and Vězda 1994, Puntillo 1995, 1996) – it usually grows on smooth bark of broadleaved trees, in moist forests and sometimes foliicolous on *Buxus sempervirens* L. (Nimis 2016). In the Forest of Vallombrosa, we found this lichen on bark of *F. sylvatica* L. and *Abies alba* Mill. in a mixed forest of beech and silver fir, with tree coverage greater than 60%, both on north and south-facing slopes, between 920 and 1050 m a.s.l.. *Segestria leptalea* is included in the Italian Red List of epiphytic lichens and classified as "Vulnerable" (Nascimbene et al. 2013).

S. Ravera, C. Cocozza

Sphaerophorus globosus (Huds.) Vain. (Sphaerophoraceae)

+ **CAM**: Ottati (Salerno), on *Fagus sylvatica* L. (UTM WGS84: 33T 527606.4485629), 1361 m, 28 June 2016, leg. *P. Hurtado, P. Giordani, E. Bianchi*, det. P. Giordani (Herb. Bianchi). – Species new for the flora of Campania.

Sphaerophorus globosus belongs to species complex with a very wide and disjunct distribution and a substantial morphological variability. It is a fruticose and shrubby lichen, forming small to large cushions (up to 15 cm across), irregularly branched, with rare terminal apothecia (Högnabba and Wedin 2003). *Sphaerophorus globosus* is generally restricted to cold-humid areas, mostly on rocks or as epiphyte, but occasionally grows over mossy outcrops in coastal forests at low and middle elevations. This species is extremely rare in Italy, and it is probably extinct in several Regions (Nimis 2016). Due to its rarity, it is included in the Italian Red List of epiphytic lichens under the "Vulnerable" category (Nascimbene et al. 2013). The record reported here refers to a fairly large population, colonizing a dozen large beech trees in an undisturbed open stand, within the epiphytic communities of the *Lobarion pulmonariae*.

P. Hurtado, P. Giordani, E. Bianchi

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Supplementary material 1

Figure S1
Authors: Giulio Pandeli
Data type: JPG image
Explanation note: *Tortella mediterranea* Köckinger, Lüth, O.Werner & Ros – A Plant. B Leaf C Shoot habit, dry D Shoot habit, moist E Stem cross-section F Leaf cross-section G Leaf margin at mid-limb with elongated marginal cells. Photographs by G. Pandeli.

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RESEARCH ARTICLE

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Contribution to the floristic knowledge of Sillaro, Santerno, and Senio high valleys (Toscana, Italy)

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Abstract

The inventory of the taxa collected during the annual field trip of the working group for Floristics, Systematics and Evolution of the Italian Botanical Society is reported. The field trip was held in 2019 along the Sillaro, Santerno, and Senio high valleys located in Toscana (central Italy). The flora documented for the studied area amounts to 492 specific and subspecific taxa (including five hybrids), belonging to 254 genera and 77 families. *Bromopsis caprina*, *Ophrys appennina*, *O. classica*, *Polygala flavescens* subsp. *flavescens*, and *Pulmonaria vallarsae* subsp. *apennina* were the only five Italian endemics found in the study area, whereas 28 alien taxa were detected. Finally, nine taxa (seven native and two alien) have to be considered as new records for the regional flora of Toscana.

Keywords

Alien species, Apennine, biodiversity, endemics, floristic novelties, vascular flora

Introduction

The working group for Floristics, Systematics and Evolution of the Italian Botanical Society has been active in increasing the floristic knowledge of poorly known areas of Italy (e.g., Bartolucci et al. 2019; Stinca et al. 2019, and literature cited therein). Territories to be investigated have been generally selected based on the low number of published floristic studies, as summarized in the map of floristic knowledge of Italy (Scoppola and Blasi 2005).

Here we present the results of the field trip held in 2019 in Toscana, selecting territories poorly known based also on the analysis of the floristic knowledge reported in the online database Wikiplantbase #Toscana (Bedini et al. 2016; D'Antraccoli et al. 2018; Peruzzi and Bedini 2020+).

Materials and methods

Study area

Seemingly based on the work published by Zangheri (1966), the explored territory partially falls within an area reported by Scoppola and Blasi (2005) as "well known", and partially considered with a "general knowledge". However, according to the Wikiplantbase #Toscana database (Peruzzi and Bedini 2020+), only 327 floristic records, referring to 248 taxa, were reported for this area. About 13% of these records derived from Zangheri (1966), and 50% derived from old historical literature (Caruel 1860–1864; Baroni 1897–1908). Recent floristic data are available for surrounding areas, as Sasso di Castro-Monte Beni (Viciani et al. 2008, 2011, 2012; Peruzzi et al. 2009).

The study area includes the high valley of the rivers Sillaro, Santerno, and Senio, located in the province of Florence (municipalities of Firenzuola and Palazzuolo sul Senio) in the north-eastern part of Toscana, at the boundary with Emilia-Romagna (Fig. 1). The altitude ranges from 250 m a.s.l. at the Santerno river near Castiglioncello

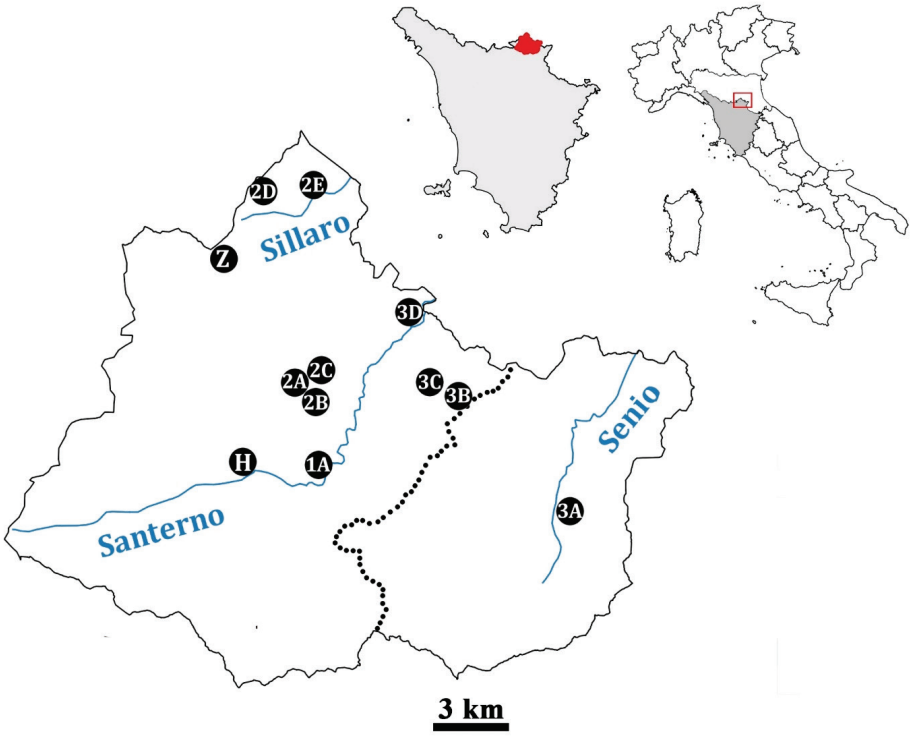

Figure 1. Study area and localization of sampling sites. Dotted line represents the boundary between the municipalities of Firenzuola (westwards) and Palazzuolo sul Senio (eastwards). For details on the sample sites, see Table 1.

to 900 m a.s.l. at Passo del Parietaio. From the geological point of view, the study area is characterized by a marly-arenaceous and marly-limestone (turbidite) sedimentary complex of Medium Miocene, with localized outcrops of ophiolite (Regione Toscana 2019).

According to the classification of Rivas-Martinez et al. (2004) and Pesaresi et al. (2017), the study area is characterized by a temperate continental submediterranean bioclimate, belonging to the vegetation series *Acero obtusati-Querco cerridis sigmetum* (De Dominicis et al. 2010a, b). Indeed, the current forest vegetation is dominated by broad-leaved deciduous trees (mainly *Quercus cerris* L.). Other vegetation types occurring in the study area include rocky areas with therophytic communities, ophiolitic outcrops, pastures with mixed shrubs, badlands ('calanchi') and riparian zones.

Sampling and identification

In order to optimize the sampling, 12 sites were selected basing on 3 criteria: (a) to maximise the environmental heterogeneity among sampling sites, (b) to fall in the less-explored areas according to the available floristic knowledge, and (c) to ensure the sampling representativeness of all the tree valleys (Table 1).

Table 1. List of sampling sites, with reference number, locality name, altitude, main habitat, geographic coordinates and date of collection.

ID	Locality	Habitat	Altitude (m a.s.l.)	Coordinates	Date
1A	Firenzuola (Firenze), Santerno valley, hills east of the village of San Pellegrino	Thermophilous rocky environments, and woods with a prevalence of chestnut	350–530	44°07'16.9"N, 11°25'57.3"E	15 May 2019
2A	Firenzuola (Firenze), Santerno valley, along the pathway CAI 721 from the locality Cerreta to the ruins of the San Biagio alle Piagnole Church	Mixed broadleaved deciduous woods	365–565	44.149328"N, 11.425273"E	16 May 2019
2B	Firenzuola (Firenze), Santerno valley, along the pathway CAI 721 on the north east side of the Mt. Coloreta in the vicinity of the San Biagio alle Piagnole Church	Rocky environments	565–600	44.146741"N, 11.424881"E	16 May 2019
2C	Firenzuola (Firenze), Santerno valley, along the riverbed of the Diaterna torrent in the locality Cerreta	Riverbed and meadows	340–380	44.151941"N, 11.426096"E	16 May 2019
2D	Firenzuola (Firenze), Sillaro valley, Sasso della Mantesca	Ophiolitic rocky environments, shrub formations and pastures	780–860	44.220403"N, 11.396629"E	16 May 2019
2E	Firenzuola (Firenze), Sillaro valley, along the Sillaro torrent, near Piancaldoli	Riparian habitat, meadows and abandoned arable lands	460–480	44.216491"N, 11.428498"E	16 May 2019
3A	Palazzuolo sul Senio (Firenze), Senio valley, along the blue pathway n° 10 from Palazzuolo sul Senio to the ruins of Castellaccio	Mixed broadleaved deciduous woods, clearings and rocky environments	445–585	44.108831"N, 11.546825"E	17 May 2019
3B	Firenzuola (Firenze), Santerno valley, along the street SP32 named "della Faggiola" near the Parietaio Pass	Meadows and pastures	850–900	44.14761"N, 11.49833"E	17 May 2019
3C	Firenzuola (Firenze), Santerno valley, along the street SP32 named "della Faggiola" on the south east side of Poggio Stignano	Pastures, shrub formations and eroded lands (named "calanchi")	700–750	44.14980"N, 11.48833"E	17 May 2019
3D	Firenzuola (Firenze), Santerno valley, along the pathway from the riverbed of the Santerno river to the ruins of Castiglioncello	Ruins, meadows and edges of the forest	250–350	44.175174"N, 11.481944"E	17 May 2019
H	Firenzuola (Firenze), Valle del Santerno, in the locality Contessa Lina in the ground of the Hotel Gli Orzali	Meadows	450–500	44.110387"N, 11.386196"E	15–18 May 2019
Z	Firenzuola (Firenze), Sillaro valley, Sasso di San Zanobi, along the pathway around and on the top of the "Sasso"	Meadows and ophiolitic rocky environments	850–860	44.197493"N, 11.384966"E	18 May 2019

The sites were preliminarily investigated on March 20th–22nd and May 1st 2019 by the organisers, then sampled during the period May 15th–18th 2019 by all participants. A comparative revision of critical collections and of unidentified specimens collected during the field work was carried out at the University of Pisa on February 5th–7th 2020.

The nomenclature of taxa follows the updated checklists of the vascular flora native (Bartolucci et al. 2018) and alien (Galasso et al. 2018) to Italy and subsequent updates summarised in the Portal to the Flora of Italy (2020+; see also Martellos et al. 2020), except for native hybrids, not considered in the above-mentioned checklists. In the floristic list (Suppl. material 1, Part 3), the systematic order of the families follows Bartolucci et al. (2018) and Galasso et al. (2018). Within each family, taxa are ordered alphabetically. For each taxon, after the accepted scientific name, the following information is reported: endemic, cryptogenic and alien status, sampling locality, herbarium in which the collection is conserved (Suppl. material 1, Part 2). Abbreviations or symbols used in the floristic list are: E Italian endemic (according to Peruzzi et al. 2014, 2015; Bartolucci et al. 2018; Portal to the Flora of Italy 2020+); A Alien taxon and its status in Toscana: CAS (casual), NAT (naturalized), INV (invasive)]; C Cryptogenic taxon (doubtfully native taxon, whose origin of occurrence in Italy is unknown); N New record for the flora of Toscana.

Results

During the field investigations a total of 2,860 specimens were collected, belonging to 492 species and subspecies, 254 genera, and 77 families (Suppl. material 1, Part 3), including two native (*Glechoma* ×*pannonica* Borbás and *Salix apennina* A.K.Skvortsov × *S. caprea* L.) and two alien (*Vitis* ×*instabilis* Ardenghi, Galasso, Banfi & Lastrucci and *V.* ×*koberi* Ardenghi, Galasso, Banfi & Lastrucci) hybrids.

Bromopsis caprina (A.Kern. ex Hack.) Banfi & N.G.Passal., *Ophrys appennina* Romolini & Soca, *O. classica* Devillers-Tersch. & Devillers, *Polygala flavescens* DC. subsp. *flavescens*, and *Pulmonaria vallarsae* A.Kern. subsp. *apennina* (Cristof. & Puppi) L.Cecchi & Selvi were the only five Italian endemics found in the study area.

A total of 28 alien taxa were detected of which 5 are casual, 16 naturalized and 7 invasive aliens (*Ailanthus altissima* (Mill.) Swingle, *Artemisia verlotiorum* Lamotte, *Robinia pseudoacacia* L., *Senecio inaequidens* DC., *Veronica persica* Poir., *Vitis* ×*instabilis* Ardenghi, Galasso, Banfi & Lastrucci, and *V.* ×*koberi* Ardenghi, Galasso, Banfi & Lastrucci).

Besides *Bromopsis caprina*, eight taxa (six native and two alien) are new for the regional flora of Toscana: *Campanula portenschlagiana* Schult. (casual alien), *Crepis albida* Vill. subsp. *albida*, *Hypochaeris laevigata* (L.) Ces., Pass. & Gibelli, *Potentilla neglecta* Baumg., *P. pusilla* Host (Fig. 2), *Pyrus nivalis* Jacq., *Rumex cristatus* DC. (regional casual alien), and *Taraxacum limosicola* Kirschner & Štěpánek.

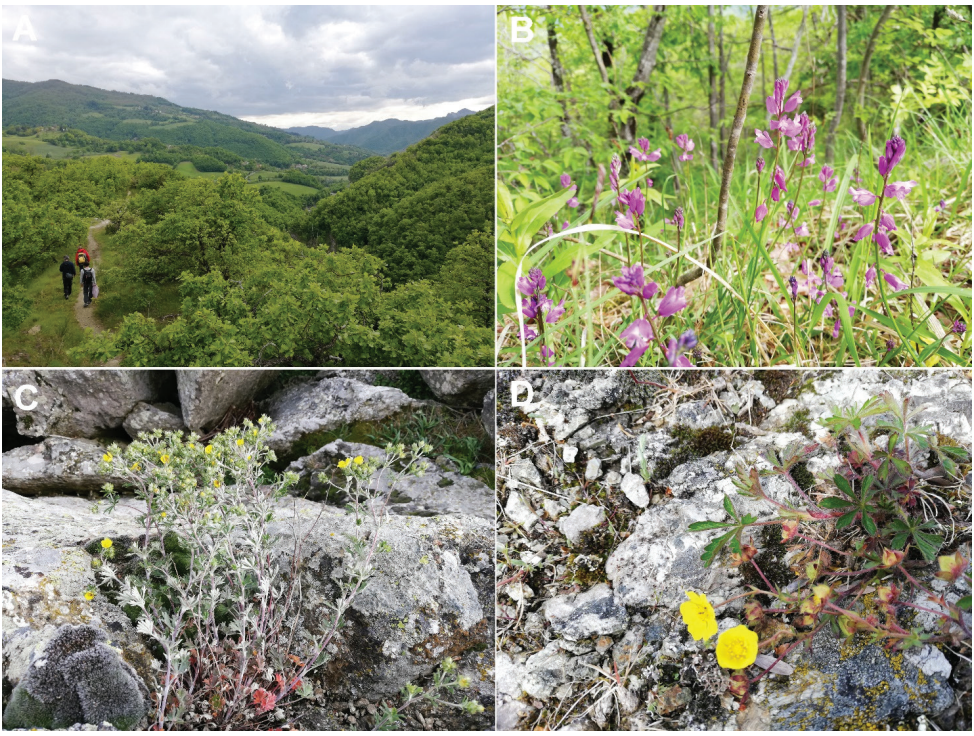

Figure 2. A view from the site 3D in Castiglioncello (Firenzuola, Firenze) (**A**); *Polygala nicaeensis* subsp. *mediterranea* from site 2A (**B**); *Potentilla neglecta* (**C**) and *P. pusilla* (**D**) from site 2D, both new records for the flora of Toscana. For details on the sample sites, see Table 1. All photographs by L. Peruzzi.

Discussion

Among the 492 species and subspecies identified in this work, five are Italian endemics that occur in many other Italian regions, and are included in the Red List of the Italian endemic flora (Orsenigo et al. 2018, 2020) as LC ("Least Concern") with the exception of *Polygala flavescens* subsp. *flavescens*, which is reported as DD ("Data Deficient"). Among them, *Bromopsis caprina* was so far reported only for Lazio, Abruzzo, Campania, Basilicata, and Calabria (Bartolucci et al. 2018). This species was found only in a thermophilous rocky environment at the site 1A.

Concerning the native flora, besides *B. caprina*, six taxa are new for Toscana (Bartolucci et al. 2018). *Crepis albida* Vill. subsp. *albida*, found in the site 1A, reaches in this region its eastern distribution limit, occurring in France, Germany and in Italy only in Piemonte and Liguria (Greuter 2006+; Bartolucci et al. 2018). *Potentilla neglecta* occurs in Italy in Veneto, Trentino-Alto Adige, Abruzzo, and Lazio (Bartolucci et al. 2018, 2019). It was found in the site 2D, growing on ophiolitic rocks. In the same locality, we also collected *Potentilla pusilla*, growing in a pasture with ophiolitic outcrops. This species reaches in Toscana its southern distribution limit, occurring in Italy from Valle d'Aosta to Emilia-Romagna (Bartolucci et al. 2018). *Pyrus nivalis*

was considered as native to Italy by Kurtto (2009), whereas Bartolucci et al. (2018) consider it as cryptogenic in Puglia and non-native in Trentino-Alto Adige. Only few individuals were found in the Santerno Valley (site 3B). Finally, still in site 2D we also collected *Taraxacum limosicola* and *Hypochaeris laevigata*. The former species belongs to *Taraxacum* sect. *Palustria* (H.Lindb.) Dahlst. (Kirschner and Stepánek 1998) and was so far reported only for Emilia-Romagna in Italy, from an area actually close this new locality (Peruzzi and Carlesi 2011). *Hypochaeris laevigata* reaches in Toscana its northern distribution limit, occurring in Sicily, Sardinia, Calabria, Basilicata, and Puglia (doubtful in Campania, Bartolucci et al. 2018). Among native non-endemic flora, *Bellevalia romana* (L.) Sweet, *Colchicum lusitanum* Brot., *Crepis albida* Vill. subsp. *albida*, *Ophrys bertolonii* Moretti subsp. *bertolonii* and *Orchis provincialis* Balb. ex Lam. & DC. are included in the Red List of the Italian flora (Rossi et al. 2013; Orsenigo et al. 2020) as LC.

Concerning *Glechoma* ×*pannonica*, the occurrence of putatively hybrid populations between *Glechoma hederacea* L. and *G. hirsuta* Waldst. & Kit. in central and northern Italy was already reported by Fiori and Beguinot (1903, under the name *Glechoma hirsuta* var. *heterophylla* (Opiz ex Rchb.) Bég.) and by Zangheri (1976, under the name *Glechoma heterophylla* Opiz). Also, Pignatti (1982) and Pignatti et al. (2018), reported the common occurrences of (unnamed) hybrids where the two parental species co-occur.

Among native species, the following 21 taxa are reported for the first time for the province of Florence (Peruzzi and Bedini 2020+, Roma-Marzio et al. 2016): *Arabis planisiliqua* (Pers.) Rchb., *Asplenium ceterach* L. subsp. *bivalens* (D.E.Mey.) Greuter & Burdet, *Bromopsis stenophylla* (Link) Lazzeri, *Campanula sibirica* L. subsp. *sibirica*, *Carex liparocarpos* Gaudin subsp. *liparocarpos*, *Cerastium brachypetalum* Desp. ex Pers. subsp. *roeseri* (Boiss. & Heldr.) Nyman, *Coronilla vaginalis* Lam., *Crepis taraxacifolia* Thuill., *Galinsoga parviflora* Cav., *Helianthemum croceum* (Desf.) Pers., *Hornungia petraea* (L.) Rchb. subsp. *petraea*, *Lamium hybridum* Vill., *Luzula sylvatica* (Huds.) Gaudin subsp. *sieberi* (Tausch) K.Richt., *Orchis mascula* (L.) L. subsp. *speciosa* (Mutel) Hegi, *Orobanche alba* Stephan ex Willd., *Poa angustifolia* L., *Rosa squarrosa* (A.Rau) Boreau, *Saxifraga exarata* Vill. subsp. *pseudoexarata* (Braun-Blanq.) D.A.Webb, *Silene nemoralis* Waldst. & Kit., *Trinia glauca* (L.) Dumort. subsp. *glauca*, and *Ziziphora granatensis* (Boiss. & Reut.) Melnikov subsp. *granatensis*. In addition, the occurrence of *Rosa pulverulenta* M.Bieb. in the site 2D, represents the first recent finding for Toscana outside Apuan Alps (Peruzzi and Bedini 2020+).

Twenty-eight out of the 492 identified taxa (5%) are non-native. Two of them are new for the flora of Toscana (Galasso et al. 2018): *Campanula portenschlagiana* and *Rumex cristatus*.

Campanula portenschlagiana is native to south-eastern Europe, and it was reported for the first time as alien in Italy for Lombardia (Banfi and Galasso 2010), and later reported as casual for Trentino-Alto Adige, Veneto, Emilia-Romagna, Umbria, and Abruzzo (Galasso et al. 2018). This species grows on an urban wall in the village of Piancaldoli, in the Sillaro valley (site 2E). *Rumex cristatus* is native to Balkans, and it was reported as cryptogenic in Sicily, but as invasive or naturalized alien in several other

Italian regions (Galasso 2008; Galasso et al. 2018). We found only few plants colonizing the edge of a route in the village of San Pellegrino, in the Santerno valley (site 1A).

Among alien species, further four taxa (*Allium shoenoprasum* L. subsp. *schoenoprasum* locally alien, *Alnus cordata* (Loisel.) Duby, *Avena sterilis* L. subsp. *ludoviciana* (Durieu) Gillet & Magne, and *Bromopsis inermis* (Leyss.) Holub subsp. *inermis*), are reported for the first time for the province of Florence (Peruzzi and Bedini 2020+, Roma-Marzio et al. 2016).

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Supplementary material 1

Supplementary data

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Data type: species data

Explanation note: **1.** Participants to the field trip of the working group for Floristics, Systematics and Evolution of the Italian Botanical Society (May 15th–18th 2019). **2.** Public and private herbaria in which the collected exsiccata are kept. **3.** Inventory of the taxa collected during the field trip held in May 2019 along the High Valley of Sillaro, Santerno, and Senio (Toscana). **4.** Pictures of selected species and landscapes shot during the field trip held in May 2019 along the High Valleys of Sillaro, Santerno, and Senio (Toscana).

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RESEARCH ARTICLE

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Chromosome numbers for the Italian flora: 10

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Abstract

In this contribution, new chromosome data regarding two taxonomically critical genera of the Italian flora, namely *Plantago* and *Sesleria*, are presented. All the specimens analysed in this paper were collected in the Italian territory and include three chromosome counts for *Plantago* (*P. albicans*, *P. crassifolia*, and *P. subulata*) and two counts for *Sesleria* (*S. caerulea* and *S. nitida*).

Keywords

Cytogeography, cytotaxonomy, chromosome number instability, *Plantago*, *Sesleria*

How to contribute

Texts concerning new chromosome data should be submitted electronically to Giovanni Astuti (gastuti@biologia.unipi.it), including indications on voucher specimens and methods used.

Chromosome counts

Plantago albicans L. (Plantaginaceae)

Chromosome number. $2n = 20$ (Fig. 1)

Voucher specimen. Italy. Basilicata. Madonna delle Grazie (Pisticci, Matera) (WGS84: 40.374528N, 16.557667E), stenomediterranean dry grasslands developed on quaternary marine sands, 150 m, 28 May 2001, *R. Di Pietro* (HFLA).

Method. Squash preparations were made on root tips obtained from living plants. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine for 7–8 minutes.

Observations. In the last ten years, narrow leaved plantains have been the subject of accurate taxonomic and nomenclatural revisions which led to numerous changes in their classification (Di Pietro et al. 2013; Di Pietro and Iamonico 2014a, b; Hassemer et al. 2017; Iamonico et al. 2017). On the contrary, the karyological data available at present for the Italian territory are few. *Plantago albicans* is a steno-Mediterranean species which in Italy occurs in the following administrative regions: Puglia, Basilicata, Calabria, Sicilia, Sardegna, and Liguria (Bartolucci et al. 2018). Fedorov (1969) listed a number of chromosome counts from north Africa: $2n = 10$, 12, 20, 24 and 30. Badr and El-Kholy (1987), found solely a chromosome number of $2n = 30+3B$ for Egyptian populations, whereas Puech (1987, 1988) found different chromosomal numbers between Tunisian populations from the north ($2n = 20$) and south ($2n = 10$) of the country, and Vogt and Oberprieler in Marhold (2009) reported $2n = 10$ for plants from Morocco. Furthermore, Maamri et al. (2016), for Algeria, found a different chromosome number associated to different altitudinal belts. In fact, they recorded $2n = 10$ and $2n = 20$ from *P. albicans* populations collected at medium-altitude and high-altitude sites, respectively. In addition, they found various intermediate chromosome numbers ($2n = 6$, 8, 9, 12, 14, 15, 17, 18) interpreted as aneuploid cytotypes. As far as Europe is concerned, Runemark (1967) reported $2n = 30$ for Aegean populations. In Italy, hexaploid karyotypes ($2n = 30$) were reported by Bartolo et al. (1978) and Brullo et al. (1985) for Sicilian populations and by Peruzzi and Cesca (2002) for Calabrian populations. In our study, we have analysed 13 plates and we have always counted $2n = 20$ chromosomes. This result is interesting as this number has never been reported so far for Italian populations, whereas it was already found in populations from Spain (Lorenzo-Andreu 1951) and France (Rahn 1957). Although *P. albicans* exhibits a high karyological and phenotypic variability, it may be possible to highlight a geographical separation between a south-eastern area (North Africa, Greece, Sicily, and southern Calabria) with $2n = 30$ chromosomes and a south-western area (continental Italy, Portugal, Spain, and France) with $2n = 20$ chromosomes. Puech et al. (1998) pointed out that the two groups are also differentiated from a functional point of view due to the fact that the $2n = 30$ cytotype exhibits a

Figure 1. *Plantago albicans* L. from Madonna delle Grazie (Pisticci, Matera), 2*n* = 20. Scale bar: 10 μm.

much shorter seed germination period than the 2*n* = 20 one. According to the same author, this feature could represent an evolutionary advantage in places where the wet season is usually very short.

Plantago crassifolia Forssk. (Plantaginaceae)

Chromosome number. 2*n* = 20 (Fig. 2)

Voucher specimen. Italy. Puglia. Saline di Punta della Contessa (Brindisi) (WGS84: 40.615361N, 18.024000E), temporarily inundated sands characterizing retrodunal areas (*Schoeno nigricantis-Plantaginetum crassifoliae* Br.-Bl. 1931), 1 m, 20 May 2008, *R. Di Pietro* (HFLA).

Method. Squash preparations were made on root tips obtained from living plants. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine for 7–8 minutes.

Observations. *Plantago crassifolia* is a Mediterranean species which occurs throughout southern Italy with the exception of Campania, and in Emilia-Romagna, Veneto, and Friuli-Venezia Giulia (Bartolucci et al. 2018). In the studied population we found chromosome number 2*n* = 20, which confirms the karyological literature for Sicily (Brullo et al. 1985) and for Puglia itself on the Gargano Promontory (Snogerup 1985), Porto Cesareo (Peruzzi 2003) and for unspecified localities (Tornadore and Marcucci 1988). The number 2*n* = 20 was also found by Böcher et al. (1955) from southern France and confirmed by Chater and Cartier (1976).

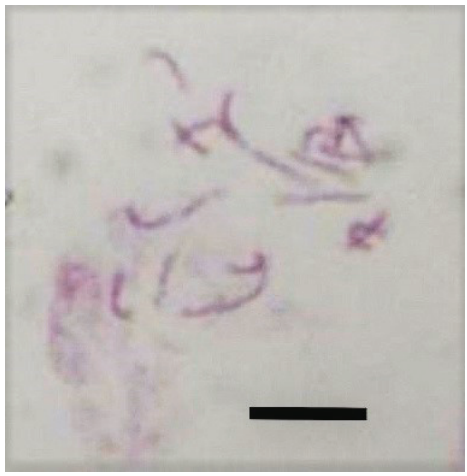

Figure 2. *Plantago crassifolia* Forssk. from Saline di Punta della Contessa (San Godenzo, Brindisi), 2*n* = 20. Scale bar: 10 μm.

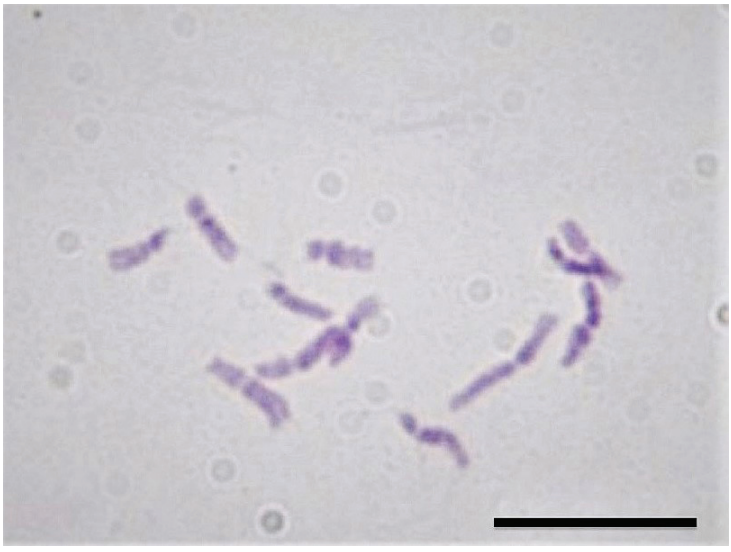

Figure 3. *Plantago subulata* L. from Isola di San Domino (Isole Tremiti, Foggia), 2*n* = 12. Scale bar: 10 μm.

Plantago subulata L. (Plantaginaceae)

Chromosome number. 2*n* = 12 (Figs 3, 4)

Voucher specimens. Italy. Puglia. Torre dell'Orso (Melendugno, Lecce) (WGS84: 40.268722N, 18.439611E), rocky coastal areas on limestone, 1 m a.s.l., 20 May 2008, *R. Di Pietro* (HFLA); Isola di San Domino (Isole Tremiti, Foggia) (WGS84: 42.120972N, 15.495389E), rocky coastal side 12 May 2002, *M. Cutini* (HFLA).

Method. Squash preparations were made on root tips obtained from living plants. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy

Figure 4. *Plantago subulata* L. from Torre dell'Orso (Melendugno, Lecce), 2*n* = 12. Scale bar: 10 µm.

fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine for 7–8 minutes.

Observations. Prior to Hassemer's review (2018), the following narrow-leaved plantains were considered to occur in Puglia: *Plantago grovesii* Brullo (a local Apulian endemic taxon whose distribution area is restricted to a narrow strip of rocky Adriatic coast of the southern Salento Peninsula from Torre dell'Orso to Otranto), *P. holosteum* Scop. subsp. *holosteum* (submontane and montane belt of Mount Gargano), and *P. holosteum* Scop. subsp. *scopulorum* (Degen) H-ic' restricted to the Tremiti Archipelago. In his recent revision, Hassemer (2018) synonymised all these species, together with other southern European narrow-leaved plantains occurring in Italy, such as *P. insularis* Gren. & Godr. and *P. humilis* Guss., to *P. subulata* L. and this classification was also followed in Bartolucci et al. (2018). From a karyological point of view, however, the literature referring to *P. subulata* s.l. is very variable. If we consider only the samples referring to *P. subulata* L. s.str., these show a chromosome number of 2*n* = 2*x* = 12 (Contandriopoulus 1962). On the other hand, samples from Sardinia (= *P. insularis*), Sicily (= *P. humilis*) and North Africa (= *P. subulata* subsp. *atlantis* (Emb. & Maire) Greuter & Burdet) show 2*n* = 4*x* = 24 chromosomes (Contandriopoulus 1962; Corrias 1980). Currently, the most relevant hypothesis (Contandriopoulus 1962; Brullo et al. 1985) consider the tetraploid taxa as derived from a diploid *P. subulata*. In our karyological investigation, the Apulian specimens of *P. subulata* analysed (formerly attributed to *P. grovesii* and *P. holosteum* subsp. *scopulorum*) were quite similar and both provided a chromosome number 2*n* = 12. However, the three aforementioned taxa occurring in Puglia seem to be morphologically quite dissimilar from one another (personal observations), besides being clearly separated geographically. For this reason, further investigations are necessary to clarify their taxonomic status.

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Figure 5. *Sesleria caerulea* (L.) Ard. from Bosco delle Tagliate (Capo di Ponte, Brescia), 2*n* = 28. Scale bar: 10 μm.

Sesleria caerulea (L.) Ard. (Poaceae)

Chromosome number. 2*n* = 28 (Fig. 5)

Voucher specimen. Italy. Lombardia. Val Camonica, Bosco delle Tagliate, Pescarzo (Capo di Ponte, Brescia) (WGS84: 46.032639N, 10.318400E), undergrowth of *Ostrya carpinifolia* woods 25 October 2005, *R. Di Pietro, G. Ciaschetti, S. Armiraglio, M. Caccianiga, E. Bona* (HFLA); **Trentino-Alto Adige.** Mezzolombardo (Trento) (WGS84: 46.219833N, 11.083031E), chasmophytic vegetation on limestone cliffs in the hilly belt, 15 March 2006, *R. Di Pietro & P. Fortini* (HFLA).

Method. Squash preparations were made on root tips obtained from living plants. Root tips were pre-treated with 8-hydroxyquinoline 0.002M for 24 hours at 4 °C temperature and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C for 7–8 minutes, the tips were stained in leuco-basic fuchsine for 2–3 hours. Subsequently an enzymatic treatment of approximately 10–20 minutes with 10% pectinase solution and powdered cellulase in 5% solution was carried out.

Figure 6. *Sesleria nitida* Ten. from Pian de Valli (Vazia, Rieti), 2*n* = 28. Scale bar: 10 μm.

Observations. The genus *Sesleria* in Italy has been the object of an accurate taxonomic-nomenclatural revision (Brullo and Giusso Del Galdo 2006; Foggi et al. 2007; Di Pietro et al. 2013, 2015; Alonso et al. 2015; Di Pietro et al. 2017). It is well-known that in *Sesleria*, the ploidy level has a great discriminatory power for taxonomic classifications (Ujhelyi and Felföldy 1948; Strgar 1979; Di Pietro et al. 2005; Trombetta et al. 2005; Di Pietro 2007; Lazarević et al. 2015). *Sesleria caerulea* (= *S. varia* (Jacq.) Wettst.; *S. albicans* Kit ex Schult) is generitype of *Sesleria* (Foggi et al. 2001). In Italy, this species is widespread throughout the Alps and pre-Alps; it occurs also in a few relic sites in the western side of the northern Apennines. From the karyological point of view there are numerous karyological data available for this species published especially in eastern Europe (Májovský 1976; Lysák et al. 1997; Lysák and Doležel 1998; Petrova 2000; Budzáková et al. 2014), all reporting 2*n* = 4*x* = 28 chromosomes. Recently, Lazarević et al. (2015) found octoploid individuals in two *S. caerulea* populations from the Julian Alps. This is the first count for Italy.

Sesleria nitida Ten. (Poaceae)

Chromosome number. 2*n* = 28 (Fig. 6)

Voucher specimen. Italy. Lazio. Monte Terminillo, Pian de Valli (Vazia, Rieti) (WGS84: 42.453639N, 12.987333E), dry grasslands on rocky limestone slopes, 25 June 2003, *R. Di Pietro, A. Granati* (HFLA).

Method. Squash preparations were made on root tips obtained from living plants. Root tips were pre-treated with 8-hydroxyquinoline 0.002M for 24 hours at 4 °C

temperature and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C for 7–8 minutes, the tips were stained in leuco-basic fuchsine for 2–3 hours. Subsequently an enzymatic treatment of approximately 10–20 minutes with 10% pectinase in 10% solution, and powdered cellulase in 5% solution was carried out.

Observations. *Sesleria nitida* Ten. is a species endemic to the central and southern Apennines and Sicily. Our chromosome count confirms what was already reported for this species by Ujhelyi (1960) and by Trombetta et al. (2005).

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